MAY 31 1921

IN THIS ISSUE:

THE ROGER BACON MANUSCRIPT
ELECTRIC TRAINS WITHOUT CREWS

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SCIENTIFIC AMERICAN

A Weekly Review of Progress in

INDUSTRY · SCIENCE · INVENTION · MECHANICS

AN AERIAL GREYHOUND RIDING AT ANCHOR: HOW THE DIRIGIBLE MOORING MAST IS EMPLOYED

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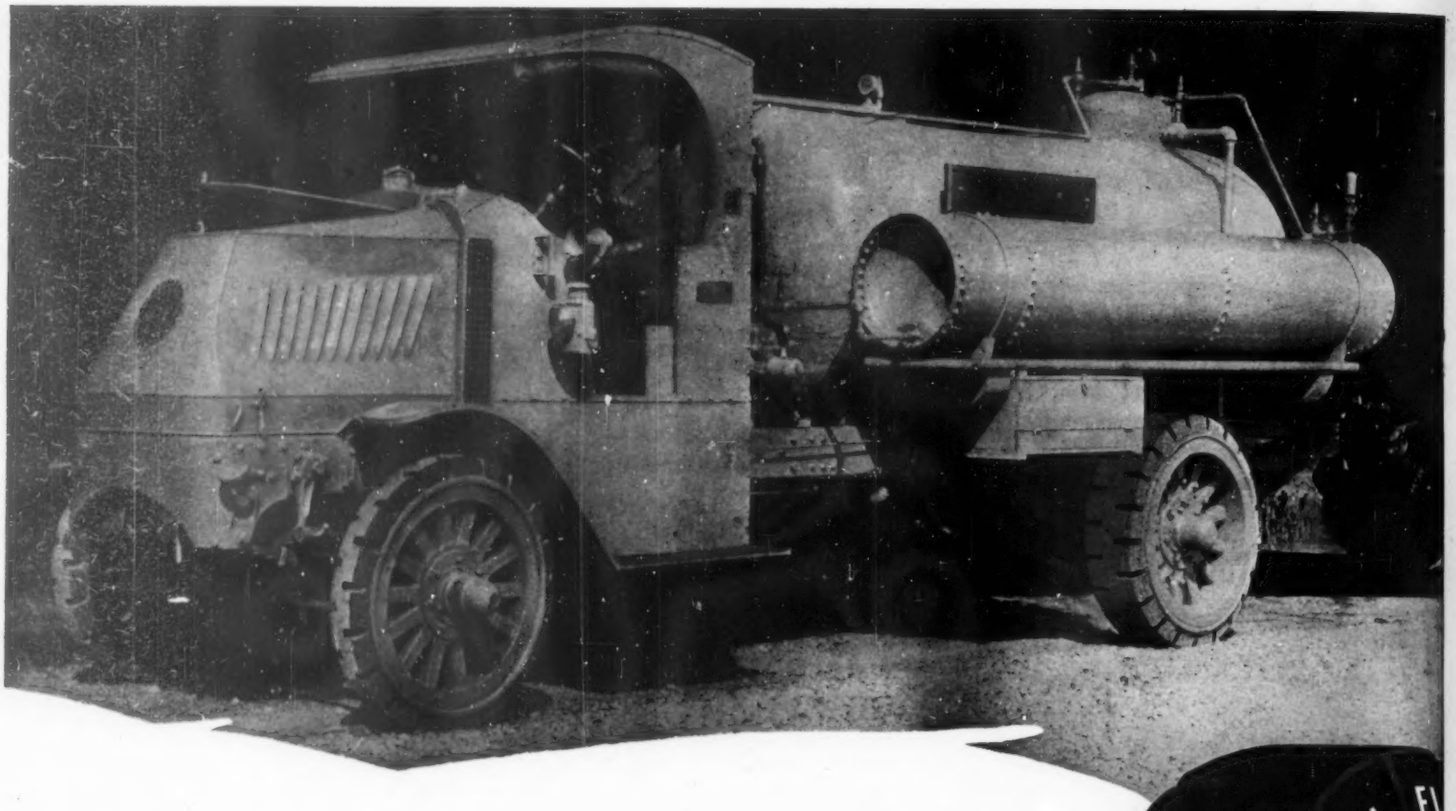


This truck travels in loose gravel or crushed stone 6 to 8 inches deep

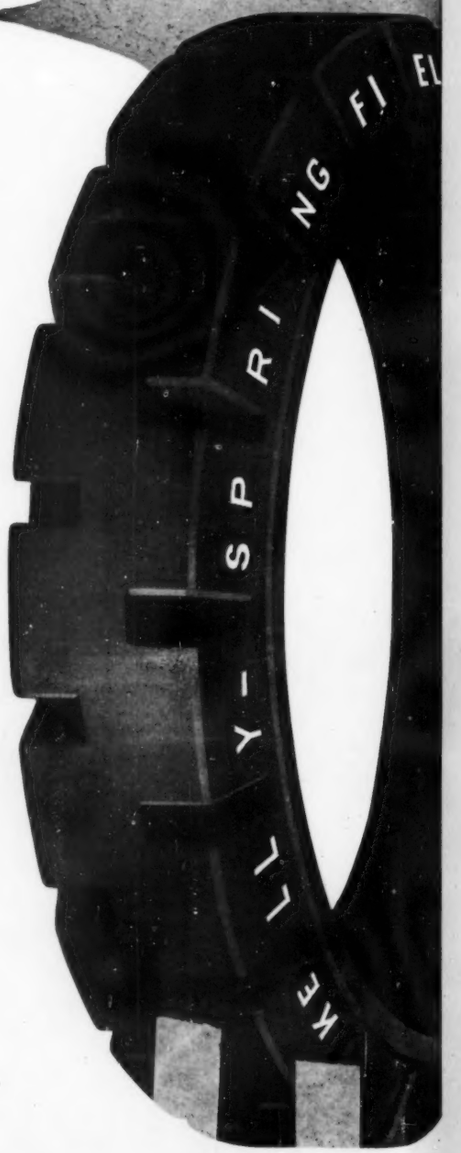
NEARLY every truck owner is confronted with a traction problem of some kind, but that of Mr. Sam Finley, owner of the truck pictured above, is decidedly unusual.

Mr. Finley has a patented process for making roads. The large center tank of the truck is filled with road tar and the smaller tanks at each side with compressed air under pressure of about 800 pounds to the square inch. By means of the compressed air the tar is blown down into the gravel or crushed stone to form the road bed.

Not only is it necessary for the truck to travel over loose gravel or crushed stone six or eight inches deep, but it must travel at a steady, even gait in order to distribute the tar evenly. The slightest difficulty in getting traction would be fatal to the success of the work.

Shod with ordinary tires this big truck simply sank into the gravel or crushed stone as in soft mud or sand, but since it has been equipped with Kelly Caterpillar Tires it experiences no difficulty whatever in rolling right along over the unstable roadbed. Mr. Finley says that his trucks could not be operated at all without Caterpillar Tires.

What are your traction problems? They are probably not the same as Mr. Finley's, but no matter what they are, you can depend on Caterpillars to solve them.



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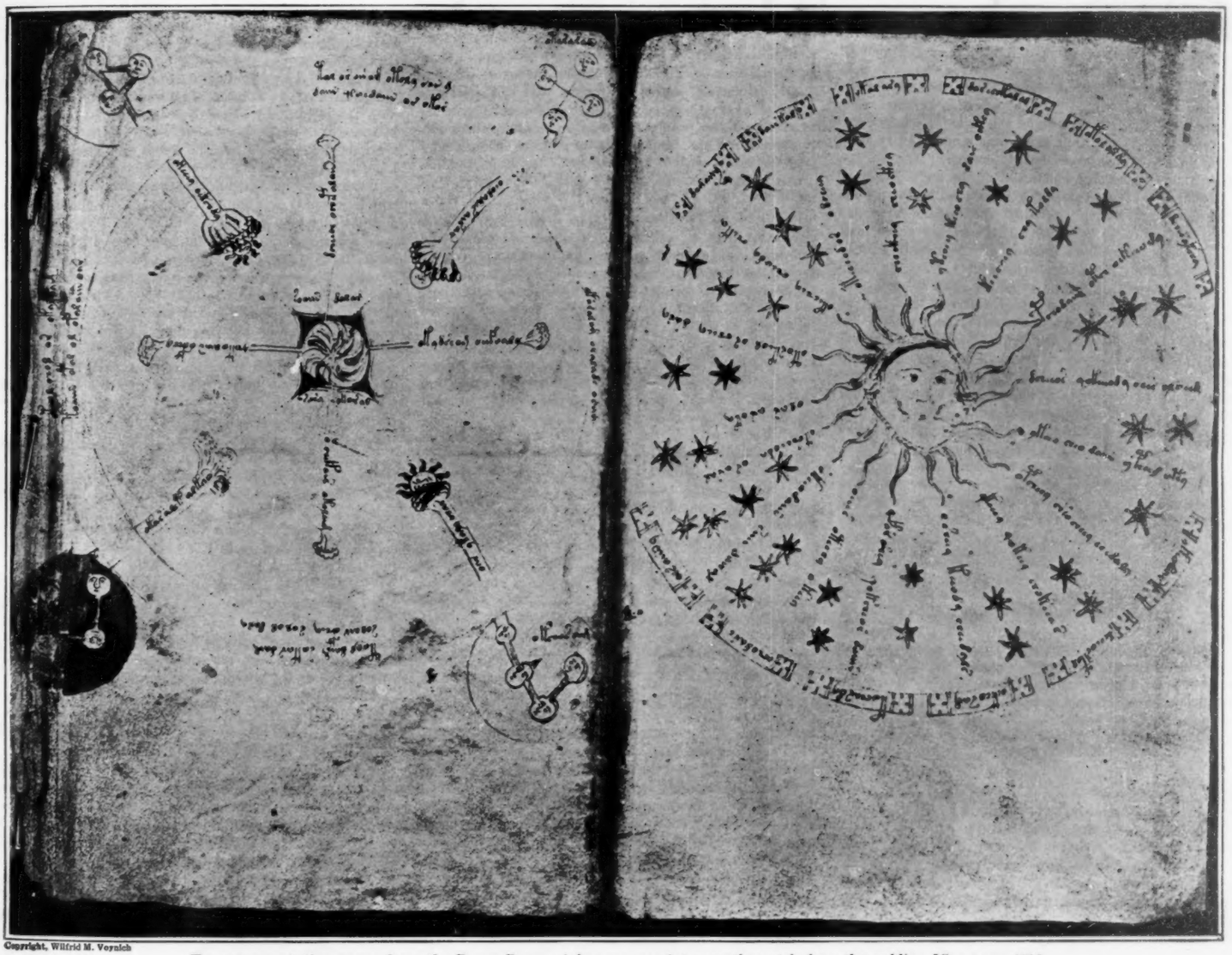

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Two representative pages from the Roger Bacon cipher manuscript recently put before the public—[See page 432]

THE page at the left is the one in which the translator finds reference to an annular eclipse on a date in the thirteenth century when such an eclipse is known to have occurred. The central picture, if this interpretation of the cipher be correct, represents the eclipse, the projecting corners being doubtless due to a combination of the artist's weakness in all matters of detail and his effort to represent the solar prominences as he saw them during the eclipse. The other drawings surrounding the central one are in several ways strongly suggestive of the presumably biological pictures in other parts of the book. Whether we are to infer that the scribe was trying to establish some connection between the eclipse and the subject which he was discussing with such drawings, or whether this juxtaposition is merely evidence that the cipher and the central drawing have been misinterpreted, must be left to the individual reader to decide for himself. The right-hand page is plainly on some astrological subject, but has not yet yielded to the translator's attack.—[See page 432]

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The Senate and the People

PRESUMABLY, in a democratic or popular form of government such as our own, it is the duty of the Senate to consult the wishes of the people of the United States and to govern themselves accordingly when they speak and vote upon the floor of the Senate. No better illustration of the functioning of this relationship has occurred than was manifested during the late war. Throughout that terrific crisis the Senate kept its hand upon the pulse of public opinion, with the result that there was a unity of thought and action which contributed immeasurably to the speedy and successful conclusion of the war.

Today the Senate is out of touch with the people. The harmony which prevailed during the war has been lost in these last few months of the peace, and today the thought and purpose of the Senate and of the people are flowing along two widely diverging channels. This division is due to public recognition of the needless scale of naval expenditure. The people who pay the taxes have learned to their amazement that last year out of every dollar of Government expenditure, 92 cents was spent in liquidating past wars and making ready for those of the future; and they have told the Senate in unmistakable fashion that Government expenditures must be reduced and that to their thinking the most effective and immediate way to set about this is to cut down the military budgets. In spite of the fact that the Navy Bill, as passed by the House, called for $400,000,000, or two-and-a-half times the peacetime expenditure before the war, the Senate wishes to add 100 million dollars to that huge sum; so that, today if you please, after two-and-a-half years of peace, and with no possible enemy in sight, the Senate is seeking to burden our already over-burdened country by imposing upon it an expenditure for the Navy for one single year, of about half a billion dollars.

The President has stated on various occasions that he is in favor of an international conference to secure a reduction of naval expenditures. The people of the United States have noted with deep satisfaction that the spokesmen for leading naval powers have welcomed this suggestion of our President, and they are curious to know why in the world the invitation has not been sent out. For answer they are told by various Senators that naval economy is an idle dream and that a conference just now to promote all-around retrenchment would be "premature"—premature for some mysterious reason which the public is not allowed to know.

The public, however, has a perfect right to make its own guess, and its guess is that the Senate is determined to jam through the construction of the whole of the 1916 program, conference or no conference. To do that calls for the expenditure of about 250 million dollars for six super-dreadnaughts which are not justified by the present international situation, as the following facts will show:

Naval strength is relative. We all want a strong navy, and we have got it. Great Britain was formerly the strongest naval power. She is no longer that, for we have taken, or soon shall have taken, her place. This rapid change in the situation is due to the fact that since the armistice, while we have been building 17 super-dreadnaughts, she has been building nothing and has scrapped 38 battleships and battle-cruisers, to say nothing of 83 cruisers, 300 destroyers and over 100 submarines—in other words, while we have been building warships she has been destroying them.

In view of the fact that Great Britain has already disarmed to the extent of scrapping a navy more powerful than the one we possessed in 1914, how in the world can Senator Penrose make the statement: "I look on disarmament as purely an idealistic and nebulous theory?" It looks as though this gentleman either had been living in a land of dreams, or had been indulging in a Rip Van Winkle sleep. But there is none of the soothing of sleep or the magic of dreams about an appropriation of 500 million dollars as an added burden upon the already burdened purse of the good citizens of the United States.

Senator Borah has the people behind him in his plea for an immediate international conference. The Senate should act accordingly.

A New Dispensary of Popular Science

IN the absence of a benevolent despot to see that all moves as it should, any activity inevitably stands or falls, in the long run, on the basis of the degree to which it enlists public support. On this ground as well as on the ground that the citizen ought to be in a position best to avail himself of what science teaches, and to estimate at its true value the work of the serious scientist as well as the claims of the faker, it is essential that the people at large understand the aims, the spirit and the achievement of modern science, and possess in the bargain some grasp of its major details.

Our common schools, beyond which a majority of us never go, are too busy laying the foundations for a useful and an interesting life to attend to anything else. Our high schools, through which a considerable proportion of us pass in part at least, have turned their attention so strongly toward specific preparation for the serious business of earning a living that they, too, lack the time for subjects which they are inclined to regard as purely cultural and therefore incidental. Our colleges turn out men and women supposedly grounded in science, but in small numbers. And in any event, education in science is a process which may not be suspended at the end of a stated period; it must be carried on consciously throughout the span of life. A mere examination of the dictionary will demonstrate that the man who ceased the acquisition of scientific information thirty years ago would be an intellectual cripple beside the newsboy of today, and would actually be unable to pursue the ordinary life of the present generation.

This rapid advance, spelling an increased complexity, is a tremendous discouragement to the man who tries to keep up with science. He finds a gap between the place where his education stopped and the place where the current science starts—a gap which widens with each year and which he possesses no means to bridge for himself. The efforts of the popular science magazines to bridge it for him are successful in individual cases, but a material part of the public never sees these periodicals. Moreover, the editor himself finds it increasingly difficult to be sure that he has missed nothing of importance, and to pass an accurate judgment upon the things that he does not miss.

Under the financial support of Mr. E. W. Scripps, whose name is familiar to the readers of several hundred newspapers that avail themselves of his news service, a foundation has been laid in Washington which it is hoped will measure up to this situation. The charter is a wide one, enabling Science Service, as it is to be called, to publish books and magazines, to conduct lectures and conferences and to produce motion pictures. It will not at present publish any periodical of its own, believing that better results can be attained by coöperation with those already in the field, and especially by extending the willingness and the ability of the average newspaper to deal with scientific news.

Science Service, in the words of Dr. E. E. Slosson, the editorial head, will aim to act as a sort of liaison officer between scientific circles and the outside world. We may not all go as far as Tolstoy, who held that you can explain Kant to a peasant if you understand Kant well enough. But in its effort to get the best possible quality of popular science writing, and to get it before the largest possible number of readers, Science Service ought often to find it possible to function to better effect than the individual editor now is able to function. It hopes in doing this to make both ends meet, and the fact that in many cases it can do, once for all, what numerous editors have been in the habit of doing for themselves, ought to help in this direction. But if it cannot perform its mission and make both ends meet, it will perform its mission anyhow. We may all wish it success.

The Problem of a Canal at Nicaragua

A DISPATCH from Managua, Nicaragua, states that an American Government commission has begun the work of placing a valuation on the land which it would be necessary to purchase for the building of an interoceanic canal. To many of us this brief communication, tucked away in a rather obscure corner of a daily paper, brought to mind the vigorous controversy which raged some twenty years ago around the question as to whether we should build an all-American canal at Nicaragua or purchase and complete the French canal at Panama. Fortunately, common sense prevailed in this discussion, and today the shorter canal is in daily operation.

Considering that the rival canal at Nicaragua would have been about 185 miles in length as against the 50-mile length of the Panama Canal, anyone unacquainted with the topography of the country would wonder why in the world the longer canal was ever seriously considered. The answer is to be found in the existence of Lake Nicaragua, which provided a stretch of 50 miles of fresh water navigation, through a summit-level lake, which provided an abundant water supply for lockages, a problem which the engineers of the Panama Canal were able to solve only by the construction of the artificial Gatun Lake. The outflow of Lake Nicaragua is by way of the San Juan, a noble stream of great volume, with an average width of 1,500 feet, and a flood discharge which has been variously estimated at from 60,000 to as high as 150,000 cubic feet per second.

The proposal to build a canal along this route involves some novel and daring engineering work. The survey made some thirty years ago by the engineer of the Maritime Canal Company, Mr. A. G. Menocal, called for the construction of a canal with a depth of 28 feet. He proposed to extend the summit level of Lake Nicaragua, which stood at 110 feet, almost from the Pacific to the Atlantic, by the construction of two great dams, one on the Pacific slope of the western divide at a narrow gorge of the Rio Grande Valley, situated about four miles from the Pacific, and another dam at Ochoa, a point on the San Juan River, 64 miles to the east of the lake. This dam was to be a huge rock fill 2,000 feet in length, and it would have flooded both the San Juan and tributary valleys, forming a chain of lakes.

Between the Ochoa dam and the sea, the San Juan flows through low marshy land where canal construction would have been hazardous, and consequently the line of the canal was diverted from the river and located along the foothills of the valley until the Atlantic was reached at Greytown. This involved the construction of huge retaining walls to enclose the canal prism on the valley side of the canal—a construction which was severely criticised by the engineers of that day.

A comparison of the respective engineering features of the two canals shows why the choice of Panama was inevitable. Thus, the summit level of a Nicaraguan canal would have been 20 feet higher than that at Panama. The estimated total length of curvature in the Panama Canal was 22.85 miles, and the total number of degrees of curvature, 771 deg.; the Nicaragua survey called for about 50 miles of curvature, which was so sharp as to run up a total of 2,339 degrees. The estimated length at Panama was 49 miles only, against an estimated length of canal at Nicaragua of 186.53 miles; and, finally, of two 18-knot ships starting from the Atlantic for the Pacific, the one using the Panama Canal would be 378 knots out on the Pacific by the time a ship using the Nicaraguan route reached the same ocean.

The estimated cost of completing the Panama Canal was about 145 million dollars, and the cost of the Nicaraguan project, 190 million dollars. The Panama Canal was enlarged from a 28- to a 40-foot depth, and it cost nearly 400 million dollars. A Nicaraguan canal, built with the same depth and bottom and surface width throughout, we do not hesitate to say, would cost, in these days of high material and labor costs, fully 775 million dollars.

Electricity

Wireless Station at Tsingtau.—According to reports the wireless station now being erected by the Japanese in Tsingtau is expected to be in operation by August, 1921. The station will be used for commercial purposes and be open to all nationalities. The plant will have two towers, each 110 meters high.

A New Type of Neon Lamp, with a consumption of 5 watts, has been brought out for purposes where lamps are only required for indicating or signaling, and the smallest size of metal filament available for ordinary voltages has a greater consumption than is desirable. These lamps are stated to be very durable, and they give a reddish light; even smaller sizes are made suitable for illuminated signs, etc.

The Aurora and Communication.—The recent aurora which was so evident in the vicinity of New York City appears to have played havoc with telegraph, telephone and cable lines. The Western Union Telegraph Company reports that the magnetic disturbances accompanying the aurora on May 15th blew out fuses, injured electrical apparatus and did other things which had never been caused by any ground and ocean currents known in the past. It appears as though the company will probably have to send out ships to drag up the cables to repair the damage produced by straying currents.

A Fire Detector. — There has recently been introduced a compact fire detector which may be installed anywhere in conjunction with a simple electric bell and a few dry cells. The device is a highly sensitive automatic fire detector which quickly acts when the temperature rises above the ordinary. It is adjustable, can be tested, is so simple that it cannot get out of order, and can be installed by anyone. The detector may be installed in the cellar of the private house, the attic, the kitchen and elsewhere, either in single or multiple arrangement, so as to give warning of fire at the moment such fire breaks out. Again, it may be installed in the office, shop, factory or store.

Radiophone Music.—It appears very much as though we are on the verge of a new era in radio communication, namely, radiophone music for the home. The idea, in brief, is to have radiophone stations at central points sending out concert music as well as speeches and lectures via radio, and compact and simple radio receiving sets in various homes, clubs and so on to intercept the waves. Already there are several radiophone stations in operation, and at least one wireless company has developed a receiving set made in the form of a cabinet phonograph, incorporating a concealed loud-speaking telephone unit, so that the music, speech, lecture or other radiophone transmission can be heard throughout a room. It is believed by radio men that leading manufacturers of radio equipment will see fit to maintain radiophone concert and lecture services for their patrons.

Airplane as Cable Layer. — A six-mile stretch of land telegraph cables was laid and put into service in eight minutes by a plane that came from its station 40 miles away in Sweden recently. Of the eight minutes, six were spent in flight and the other two in making connections, according to *Electrical Review*. Great possibilities, both military and commercial, are seen by air service officers in this new enterprise. Equipment of planes for cable laying is simple and inexpensive. The cable is unreeled from the machine in flight with a flag marker at the end to guide signalmen on the ground to it. When over the point at the other end of the stretch of ground to be covered the wire is cut from the reel and the free end weighted, marked and dropped. The men below merely have to pick it up and connect it to begin talking with the forces at the other end.

Hot Water at the Faucet.—In the country, in the shop or factory and in other establishments where hot water is not always on tap, so to speak, the electric water heater fills what has hitherto been a serious void. There are two general classes of electric heaters, namely, the class that fits directly on the faucet, and the class that fits in the usual range boiler. The faucet type is convenient where small quantities of hot water are wanted instantaneously, without preparation of any kind. The device is connected directly with the plumbing system at the faucet, and two wires from the electric circuit serve to furnish the necessary current. The range boiler type is mounted inside the usual range boiler. The unit is always surrounded by the body of water being heated, and there is claimed to be no heat loss. The element in one of the types offered is enclosed in a seamless copper tube, eliminating corrosion for all time and affording 50 per cent quicker heat transmission, according to the manufacturer's claims.

Science

Burroughs Memorial. — The Burroughs Memorial Forest at Big Indian in the Catskill Mountains was dedicated May 6th with appropriate ceremonies. A tablet at the entrance to the forest was unveiled.

Aluminum-Bearing Deposits in Hungary.—One of the largest aluminum bearing deposits in the world has been discovered near Tapolcza, Hungary. It is believed to contain a possible deposit yielding 150,000,000 tons of aluminum.

A Two-Billion-Fish Tragedy.—A sudden freeze on January 30th of this year cost the lives of 2,000,000,000 good sized herring at Klawack Bay, Prince of Wales Island, Alaska. The fish tried vainly to get out to sea, but without avail. Expert canners gave this number of fish lost as conservative.

Fire Protection for the Holy Sepulchre.—Provision for the protection of the Holy Sepulchre against fire has been made by Sir Herbert Samuel, High Commissioner for Palestine. He recently visited this most notable shrine of Christendom and saw that no arrangements had been made to cope with fire. He ordered three portable fire pumps to be sent from England, and has presented them as a personal gift to the Latin, Greek and Armenian representatives, which exercise control over the Holy Sepulchre.

Decay of Audubon's Home.—The house where John James Audubon made his home and where Professor Morse installed and tried out his first telegraph instrument is falling into decay. It is located at Riverside Drive and 156th Street. This is a shrine at once for the naturalist, the artist and the inventor. Apartment houses are crowding all around it, but it is built on a low level so that it is hoped that the real estate operator will be estopped for the time being as the site would call for an immense foundation for a large building. In the village of Audubon in Pennsylvania all the Audubon landmarks have been carefully preserved.

Recent Light on Stonehenge.—A few months ago we published an interesting article on Stonehenge. The later developments are interesting. The use of levers and inclined planes of earth gives no satisfactory explanation, as to the raising and lowering of the great stones and seems absolutely excluded on the evidence of one of the existing lintels. This shows an enlargement of the mortises along the length of the under-side of the stone, which can only be the correction of a miscalculation discovered when the lintel was being lowered on to the tenons. To make the necessary alteration the lintel must have been removed, and this could scarcely have been effected without the use of some form of rope and a method of slinging, such as would not be at the command of a primitive and uncivilized community.

Edward B. Rosa.—Everyone who has had dealings with the Bureau of Standards will recognize the name which appears in the announcement of May 17th that Dr. Edward B. Rosa, the Bureau's chief physicist, died suddenly at his desk on that day. Born in Rogersville, N. Y., in 1861, and graduated from Wesleyan in 1886, he spent the rest of a busy life in the service of science. After studying at Johns Hopkins, and instructing at Wesleyan and Wisconsin, he entered the Bureau of Standards in 1901 and has remained there ever since. Among the work with which his name is associated are found the respiration calorimeter used in food-value investigations; the determination of the ampere; the computing of inductions; and the determination of the laws of electrolytic corrosion. During the war he was one of the heavy contributors to the development of sound ranging, the geophone, aircraft radio apparatus and directional wireless.

Development of Palestine.—Rapid progress is being made in developing Palestine under British Government for the Holy Land is now governed under a mandate. There are 600,000 inhabitants of whom only 100,000 are Jews. The Turks did everything possible during the war to ruin the country. Palestine is a very small country, and an agricultural one resembling in topography Spain or Southern Italy. There is much waste land which will be reclaimed by irrigation. It is believed that a second California can be created. Palestine now exports barley, oranges, olives, olive oil and wines. There are two growing seasons in the year, and the soil when irrigated is most productive. Near Jaffa there are 1,000 acres of vineyards. Almonds are grown there and wonderful oranges and grapefruit. The colonists are just beginning to develop the fruit growing possibilities but today throughout Palestine one can see the terraced hillsides that made the whole country a garden 2,000 years ago and it will not be difficult to make the country a garden again.

Engineering

River Erosion and Bank Protection. — From the *Railway Age* we learn that the Natchez and Southern Railroad at Natchez, Miss., has tracks which are located for some miles along the bank of the Mississippi River, and considerable trouble has been caused by erosion. A novel method of protection has been adopted, this being the restoration of the toe of the bank by sedimentation, following the construction of a mud cell dyke, the whole being finally protected with concrete slabs.

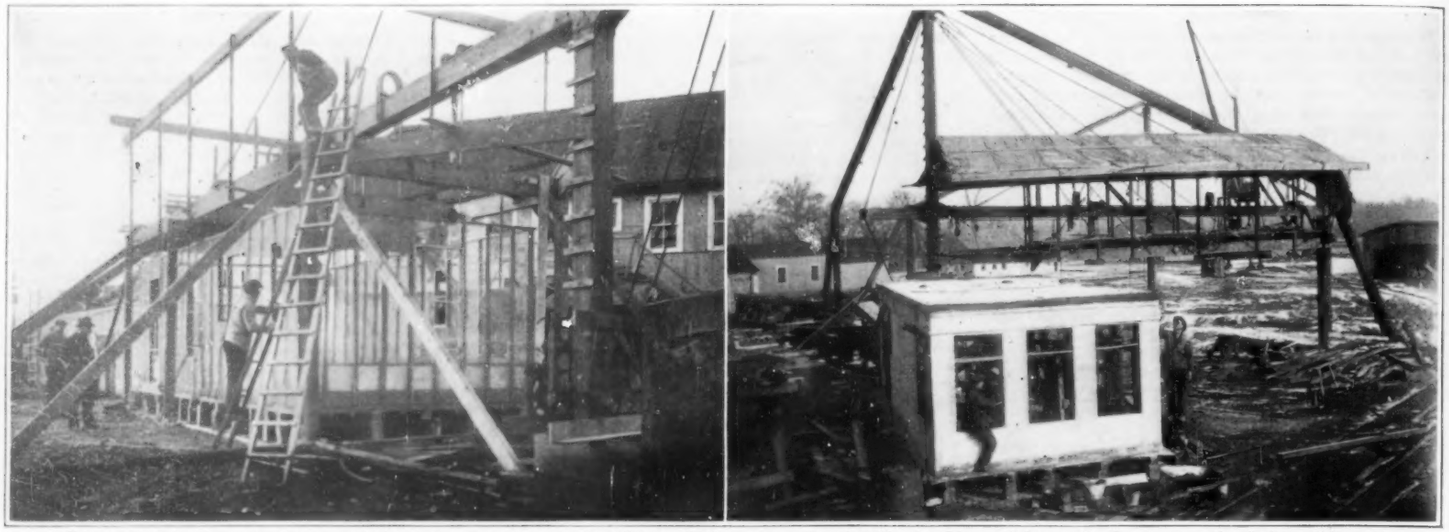
What Different Pavements Cost.—The costs of various kinds of surfacings on 3.41 miles of road, forming part of a test road built in 1912-1913 by the Bureau of Highways, Philadelphia, are given in a recent issue of *Engineering News-Record*. Twenty-six sections were laid, of which 6 were bituminous macadam mixed method, 8 bituminous penetration macadam, five of concrete base with a bituminous top, 7 vitrified brick. Averaging the first cost, interest at 4 per cent for seven years, and the maintenance, the total cost on January 1, 1920, was $1.7738 per square yard for bituminous macadam penetration sections, as compared with $2.0776 for bituminous mixed method macadam, $3.0000 for concrete, and $3.5109 for brick.

Motor Snowplows in Norway. — The motor snowplow experiments have been successful to such an extent in northern Norway that it is expected that several municipalities will adopt this method next year. As the roads are the only means of communication for most of the country, and as they are often too narrow for two sleighs to pass, it is necessary that they be kept open. The first difficulty was to obtain powerful enough automobiles or tractors. The ordinary truck and even agricultural tractor have not sufficient power to draw the plows when the snow is heavy, and it seems to be the opinion that a four-wheel drive is essential. Trucks would be preferred to tractors, if they could perform this work, because of their utility for other purposes.

Hydroelectric Power Plant in Philippines. — What promises to be the most extensive private venture of the kind in the Philippines is now well under way in the form of a hydroelectric project designed to furnish lighting and electric power to the provinces of Bataan and Pampamga, comprising a population of approximately 48,000. The Abo-Abo and Tiawir Rivers, believed to be able to yield a capacity of some 200 horsepower each, will be utilized for the project. Field explorations of the district from which the company will develop electric power has revealed the existence of large deposits of magnetic iron ore. The iron is known to stand a high degree of temperature and is very suitable for internal combustion engines. Its electric treatment has proven quite successful and the company expects to be able to exploit it to a maximum degree.

The Building Problem. — In Great Britain, France, Germany, Belgium and elsewhere, as well as in the United States, the question of the hour is housing. Many families seek to own their own home, yet with prohibitive rates for labor and materials, such hopes are soon dashed to pieces. A quite natural reaction has been a veritable avalanche of new ideas in the way of materials, equipment, and odd methods of construction which have been featured at the numerous housing expositions being held throughout the world. New York recently held a housing exposition, which was attended by tens of thousands of New Yorkers anxiously seeking ways and means of building a small cottage on their limited means. Chicago had a similar exposition; and reports come to us of expositions in London, Paris, Brussels and other European centers Never before was there a better opportunity for the man with the novel building idea.

The Port of Paris.—A scheme for the creation of inland harbors, described by M. Autrand, Prefect of the Seine, to the Improvements Committee of the Port of Paris, is of the first importance among the numerous proposals for the development of the city now being examined by municipal authorities, according to *The Times Trade Supplement*. The Port of Paris will consist of three large inland harbors: Gennevilliers, north of Paris, which will be the real maritime port of the city, and will maintain direct traffic with the sea; Bonneuil, on the Marne, which will control the upper Marne and the upper Seine; and Pontin, on the Ourcq Canal, which will be linked up directly with the Canal du Nord. All three harbors will be connected by railways with the main systems. Finally, the idea is entertained of constructing in the clayish soil around Le Gault large reservoirs which, while regularizing the flow of the Seine, will conserve considerable hydraulic power.



Two stages in the manufacture of the Lake concrete unit dwellings which are completed with plumbing, wiring and other accessories before shipment to the buyer

The One-Piece House

Simon Lake's Scheme for Producing Ready-to-Live-In Concrete Unit Dwellings and Transporting Them to the Site

By Harry A. Mount

THE housing shortage will be with us for several years to come, build as we may. The plain truth is that we cannot hope to wipe out a building shortage that has taken six or seven years to attain its present magnitude, even by the most extraordinary efforts, except by building to our utmost capacity for many years to come. If anything, the hope of ameliorating the housing shortage rests rather in the introduction of new and revolutionizing designs and methods of construction, and to that end numerous inventors, engineers and architects have directed their recent efforts. Dwellings must be simplified; materials other than wood must be employed; machinery and labor-saving equipment must be used to a greater degree, to the end that building costs may be appreciably reduced, finally bringing down the price of a modest dwelling to well within the means of the average American citizen. Conspicuous among the numerous schemes proposed is that put forward by Simon Lake of torpedo-boat fame, in collaboration with Robert C. Lafferty, a New York architect. The scheme is highly ingenious; it has been tried out with success; it is about to be put into production. The Lake concrete unit dwelling is quite small, but sufficient by itself for the requirements of the small family. At any rate, we have asked Mr. Mount to tell us about Mr. Lake's housing scheme, which he has done in the accompanying article.—THE EDITOR.

WHEN one recalls the wide heraldry given a few years ago to the scheme of Thomas Edison for building monolithic cement houses from forms or molds that were to be used over and over again, one is warned to hold within bounds his enthusiasm over similar projects. The Edison scheme was practical—is practical, in fact, and being used here and there on a small scale. It has not been applied on a universal scale, as was so confidently expected. Now comes Simon Lake of torpedo boat fame, who says he has found and removed the flaws in Edison's plan and is preparing to put his new scheme into effect on a nation-wide scale.

The most remarkable part of Mr. Lake's scheme is that, instead of building the house on the lot, necessitating a vast amount of labor for putting up and tearing down expensive forms, he will build monolithic concrete units from standardized forms in well-equipped factories, and deliver the finished house, ready for occupancy, to the lot!

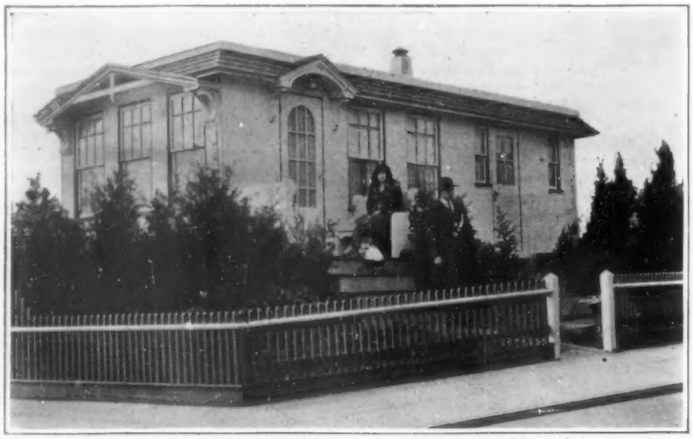
At first thought there seems to be insurmountable difficulties to any such proposition. How could a concrete house, no matter how small, be built light enough and at the same time strong enough for transportation? But supposing that were possible, where could we find a vehicle that would pick up and carry a house of any size a reasonable distance without prohibitive cost?

In finding an answer to these questions, Mr. Lake and his collaborator in the enterprise, Robert C. Lafferty, a New York architect, have departed so far from standard practise that they have had to manufacture their own engineering data as they went, and some of their answers are nothing short of startling.

For instance, the walls, floors and ceilings of the house are hollow, with only ⅜-inch thickness of cement on the inside and ⅝-inch on the outside. And yet a house of this construction has stood tests more severe than if it had passed through a half-dozen San Francisco earthquakes without a crack or a sign of structural weakness.

These tests included transportation by motor truck five miles at speeds up to 15 miles an hour. And such a motor truck! It is a specially designed ten-wheel affair, which carries the house swung low on a structural steel cradle. It is equipped with hoists, and other machinery for handling the house in putting it on and taking it off the truck. It is believed that two men can load, deliver and set up a house complete within a radius of fifty miles of the factory in one day.

As startling as are the engineering features of the house, they are hardly less so than the architectural features, the work of Mr. Lafferty. By the application of a number of ingenious devices one unit of this construction, measuring 12½ by 28½ feet, is made to serve all the practical purposes of a five-room house.



A single unit dwelling built by the Lake method and subjected to numerous tests with marked success

In a house built of more than one unit, the feature which first recommends itself is the infinite variety of combinations and finishes possible in treating both the interior and exterior. Doors, windows, walls, etc., are not arbitrarily fixed, and the effects may be varied to suit individual taste. In fact, the only limiting factor in design is the size of the units, although two of them may be combined to form a single large room. Thus it is possible to produce from these units a tiny dwelling, a mansion, or a five- or six-family apartment house.

In this connection the one-unit house is of particular interest, for it represents housing reduced to its lowest terms. These units will sell, complete and delivered on to the foundation, for as little as $1,500.

The front door opens into a little vestibule, with a coat closet. The center of the house is occupied by a combined dining and living room, although ordinarily there is no hint that it is used for meals. A large mirror on one wall, when swung down and rested on two folding legs, becomes the dining room table. This discloses, behind the mirror, a revolving server which communicates with the kitchen. When the meal is finished the dishes are piled on the server and when this is revolved they are transferred to the kitchen at the sink. The kitchen contains besides the sink a four-burner gas stove and oven, refrigerator and an electric washer. Opposite the kitchen door is the bath, fully equipped. At one end of the house, off the living room, is a small sun room with a built-in window seat. Communicating with this is a small dressing room. At the other end of the house is a den, with identical arrangement. In each of these two rooms full-sized beds disappear into the ceiling, the bottom of the bed serving as a large section of the ceiling. These beds are lowered by means of a crank in the dressing room, and at night one end rests on the window seat and the other on two folding legs.

Glass doors which may be used to shut off the sun room at night, slide back and

form doors for book cases on either side of the doorway in the daytime. The heating plant is a small stove in a fireproof alcove off the hallway, and this has been found sufficient to heat the house in the coldest weather. Further plans include a coal bin on the roof, holding two tons, arranged so that by pulling a lever the fuel drops directly into the stove.

The success of the scheme depends largely upon a unique method of construction, upon which Mr. Lake has been allowed broad basic patents. The central piece of apparatus of his unit dwelling is a huge traveling-factory, crane-like affair, on which are mounted two cement mixtures with loading hopper bins placed over them. The sand and cement are lifted to these hoppers from railroad cars, which run beneath the apparatus, by means of a grab bucket.

The cement, after mixing, flows by gravity into the forms. The frame of the house is first constructed of creosoted wood, on both sides of which is fastened heavy reinforcing netting. The window and door frames are then placed in position and the traveling plant moves to this position. There are two heavy wood forms for both inside and outside walls, one on each side of the apparatus, so arranged as to counterbalance each other, so that when one is lowered the other is raised. One of these forms is dropped over the prepared reinforcing. As door and window frames run through the walls, the frames seal these openings against cement.

The crucial part of the operation then begins. The walls are made hollow by placing in the forms the "cores" of heavy sheet iron, properly reinforced to prevent collapsing. Before placing these cores in position, they are dipped in a bath of asphalt until a coating nearly an eighth of an inch thick is deposited on them. The cores are then placed in position and the cement is poured.

Ordinarily it would be several days before the forms could be removed, and the cores would then be so tightly imbedded in the cement that they could not be removed. But warm air, held at a temperature of 180 degrees, is at once circulated through the hollow cores and a threefold result is achieved. First, the cement is dehydrated and dried within two and a half hours; secondly, the asphalt coating is melted so that the cores can be easily withdrawn; and thirdly, a heavy coating of asphalt is deposited on the inner lining of the walls, making them entirely water tight. While the cement is still warm and the pores are open so that it readily absorbs liquids, a waterproof filler, tinted in some desirable shade, is sprayed on the outside walls. The house is then picked up by the traveling machine and deposited further down the yard where it is allowed to stand two weeks to allow the cement thoroughly to harden or season in order that the house may stand the handling necessary in transporting it to its final location. Meanwhile the roof slab is placed on the four walls, the plumbing and electric wiring are completed, and the house finally finished for occupancy. Even the electric light fixtures are hung and window shades are in place when the house is finally loaded on to the big truck and trundled off!

The finished unit weighs about fifteen tons, but by means of the special truck it is readily handled by two men. If the house is to rest on piers, these are first placed and the truck then drives between them, elevates the house to the proper height and sets it down. The truck is then taken apart beneath the house and is withdrawn in two sections. These sections are subsequently reunited and the truck is ready for another trip.

The special motor truck carrier practically divides the load on two trucks comprising four forty-inch wheels each. The solid rubber tires are each fourteen inches wide, so that the hard road contact is about 350 pounds per inch. Where delivery is to be made over meadows or soft ground, a caterpillar belt will connect each adjoining pair of wheels, thus reducing the ground bearing to about 22 pounds to the square inch. The truck, it is claimed, will attain a speed of 14 miles an hour and, when fully underslung, will carry the units under an eleven-foot viaduct. The truck's elevating apparatus allows the delivery of the second story of a two-story house first. It is elevated to the proper height and propped in position. The truck is withdrawn and returns with the first story unit, depositing it beneath. The second story is then lowered in place, on top of the first story.

The smallest economical plant will consist of one traveling cement machine, woodworking, plumbing and paint shops, and four delivery trucks. The plant will complete the units at the rate of four a day. For the first plant unit of this size an abandoned shipyard has been purchased at Bridgeport, Conn., and the plant is ready to begin production. It is planned to deliver within a radius of fifty miles of this factory without extra charge, and gradually to establish branch factories in other centers of population.

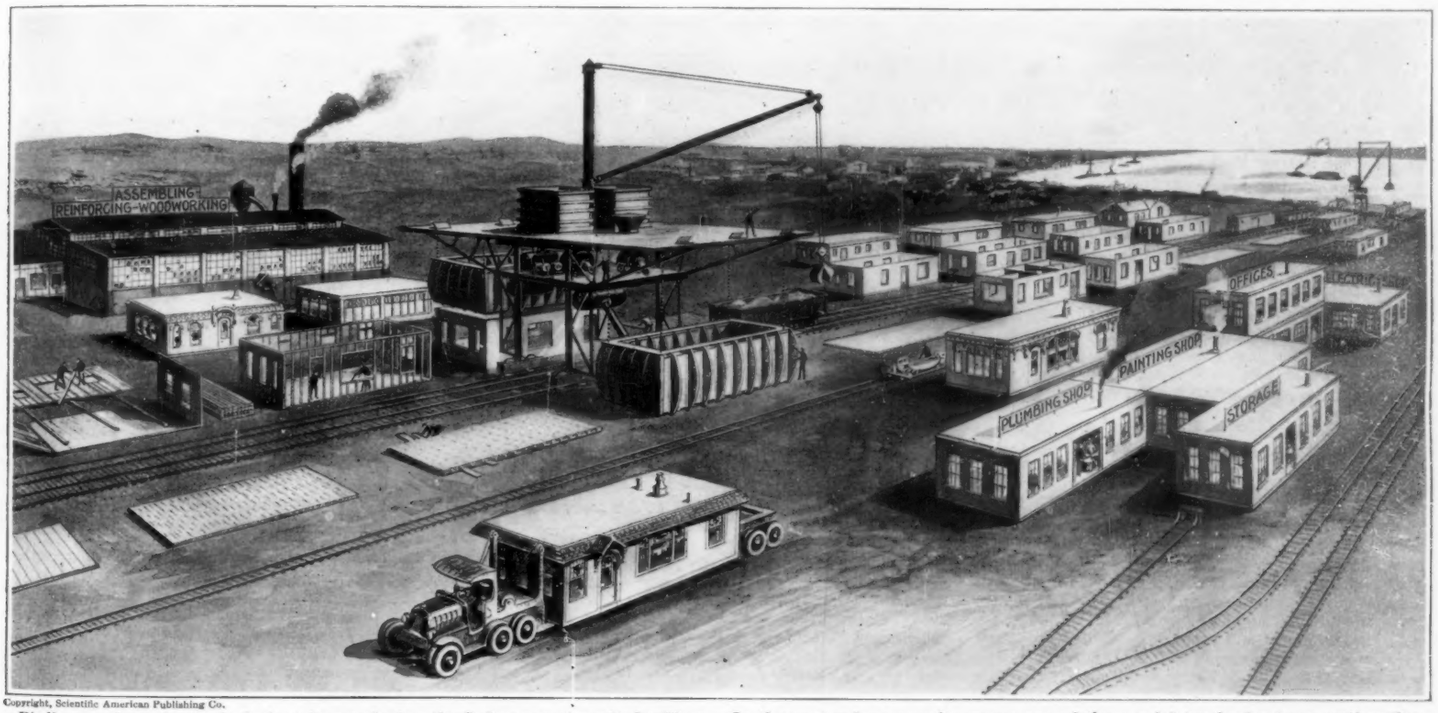
"Of course," said Mr. Lafferty, in discussing the new type of construction, "no single invention or method will solve the housing problem. It is too big for that. We cannot hope to build more than a small percentage of all the houses that are immediately needed.

"Our chief aim has been to produce a home that anyone could afford to own. I think a good remedy for the present discontent is to encourage the 60 per cent of our citizens who now live in rented homes to own their own dwellings. But even the most modest home should meet certain elementary requirements.

"First of all, the construction must be economical, no matter what it is. That excludes wood for we are using wood four times faster than we are producing it and it is certainly no longer an economical material.

"For many years cement has been recognized as an ideal building material if it can be thoroughly damp-proofed, if there is some means to dispense with the cost and waste of forms, and if, also, the requisite economy can be obtained while producing homes in an infinite variety of architectural designs.

"We think our construction meets these requirements and others. The house, by our process, is thoroughly damp-proofed. It is also heat- and cold-proof, for the hollow walls are good insulators. The house is as nearly fireproof as it can be made; the upkeep expense is minimized for no painting nor roofing is ever required. The life of the building is several times that of a frame house. We use an abundant raw material and employ the most economical production methods. We use more unskilled labor than is the customary practice. We have, in our smaller units, recognized and solved the servant problem. Other units can be added as desired. In the one-unit house seventy-five per cent of the furniture is built in, eliminating extravagant furnishings."



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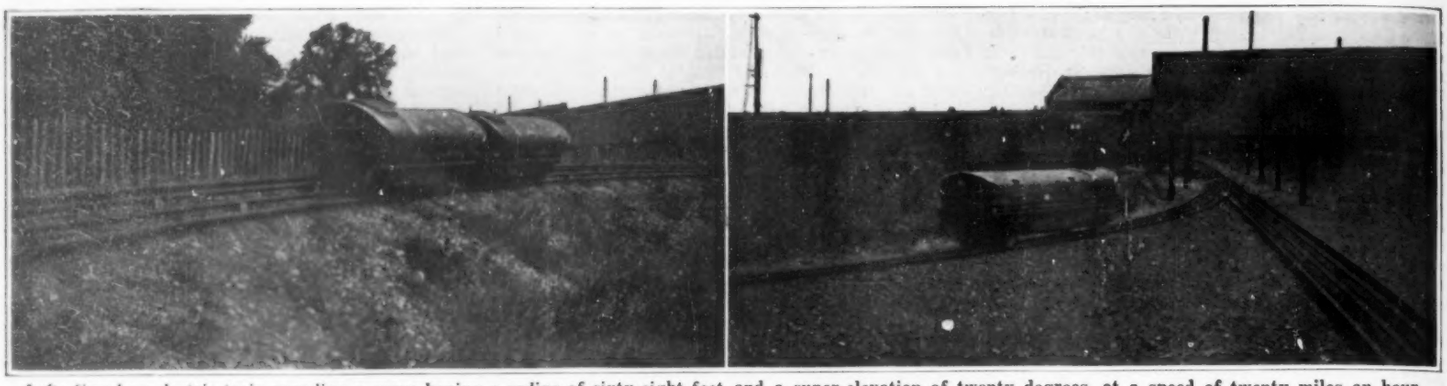
Bird's-eye view of a typical plant for producing the Lake concrete unit dwellings. In the center foreground appears one of the special trucks for transporting the unit dwellings in one piece

One-Way British Motor Plows

AMONG the most interesting of recent developments in British agricultural engineering is the one-way motor plow, which has appeared upon the British market in the form—judging from field experiments—of a successful model. Upon a commercial basis, this and other one-way plows will soon make their appearance.

The one-way motor plow has features which recommend it to all farmers whose arable land is divided into comparatively small areas, as in this country, and also to those agriculturists abroad who require to economize the space left at the headlands. One-way plowing, moreover, is a simple procedure which native labor can follow with little preliminary guidance, for there is no demand upon the operator to exhibit skill in turning in a circumscribed area at the end of the furrow and simultaneously to lift the plow out of work. The reasons for the popularity of the one-way system, therefore, are obvious.

The one-way motor plow in the present case consists of six plow breasts, three being suspended from each end of the main carriage, which is modeled on the lines of a tractor body and is driven by an engine sufficiently powerful to haul three furrows in the heaviest clay land. The forward shares are held out of work as the motor plow proceeds across the field and automatically drop into work when the machine begins its return journey. Plowing therefore becomes a succession of forward and return movements. One type of one-way plow has the advantage that it can be used as a tractor to haul another implement or a laden wagon, for the plows can be removed.



Left: Crewless electric train rounding a curve having a radius of sixty-eight feet and a super-elevation of twenty degrees, at a speed of twenty miles an hour. *Right:* A non-stop crewless train passing the station

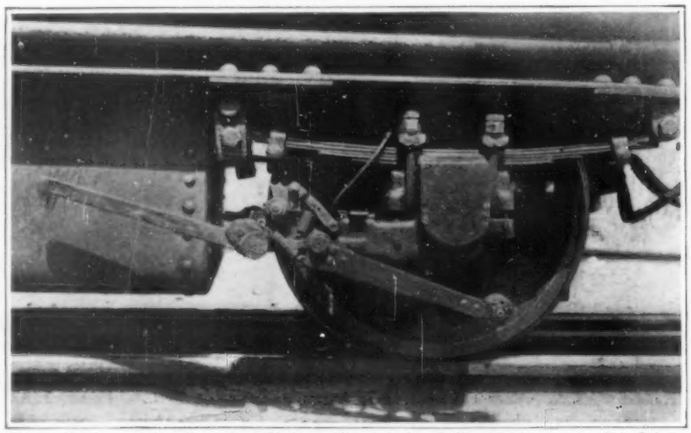
Electric Trains without Crews

An English Automatic Railway, Tested Before the War, Which Is Being Installed by the London Post Office

By Kenneth E. Stuart, A.S.M.E.

THE report of the New York, New Jersey Port and Harbor Development Commission, recently made public, presents a very comprehensive plan for the improvement of freight distribution in and about the port of New York. Among the provisions of this scheme is one that may occasion some surprise among readers of the SCIENTIFIC AMERICAN on account of its novelty, namely, the recommendation for the construction of several miles of underground railway, to be operated electrically under automatic control, *i.e.*, without motormen on the trains. Yet this is not an untried idea, an experimental railway constructed from the writer's designs having been operated in England for over three years, with very satisfactory results.

The experimental railway referred to was constructed at Chelmsford, Essex (near London), and completed in 1912. It was half a mile in length and laid mostly upon the surface of the ground, although a portion of the line passed through a concrete lined tunnel. The speed of the trains was thirty miles an hour.



The selective mechanism installed on the truck of the crewless car for determining the stopping of the car at the right station

Although it was realized that a practical solution of the problem of automatic control for electric trains would have many applications as, for instance, for urban freight, parcel and produce distribution, haulage of coal and ores over rough mining country, etc., the Chelmsford system was designed primarily with a view to solving the problem of dispatch of the mails through the phenomenally congested centers of London. As long ago as 1912, over certain routes in London, the ordinary mail traffic during the busiest part of the day amounted to as much as twenty tons of mail per hour in each direction through street congestion fully equal to that of the most congested parts of New York at the present time. The steamship mails passing through London en route for points upon the Continent were very much heavier still. It was stated in an official blue book issued about this time that the average speed of the motor mail vans in London had fallen to six miles per hour due to traffic difficulties. This was the situation that led the British Postal Authorities to intimate that they would be interested in proposals for dealing with the mails by means of an underground electric railway.

The writer felt that no form of friction brake would be suitable for driverless trains, for the reason that, with friction brakes, braking distance is uncertain, and especially so with varying loads. The writer therefore determined to use direct current propulsion, by means of shunt-wound motors, which would make it possible to employ motor braking of a very positive character, without the complication of any mechanical braking devices upon the cars. Such a system would be regenerative not only in braking, but on descending gradients, thus saving the energy usually wasted by the brakes.

The Chelmsford line was laid out in such a way as to embody all essential features of a working installation and encounter every difficulty likely to be met with in construction. The gradients ranged from level track to five per cent, both upward and downward, and in the middle of the line was a section of curve having a radius of only sixty-eight feet upon which the trains could not possibly have traveled at full speed without derailment, notwithstanding the fact that the outer rail was super-elevated twenty degrees above the inner. Although only one station was provided, it was arranged to typify either a terminal or an intermediate station with through tracks for non-stopping trains. There was also a siding in the station, a loading platform and an unloading platform, with a control table located so as to command a view of the entire station. From this table the cars could be backed off the siding, brought together for coupling into trains, moved on to the loading and unloading sections and dispatched.

As underground construction is expensive, even in London where the conditions are ideal for tunneling, the car unit was made as small as practical considerations would permit—that is to say, the cars were made just large enough to hold a mail bag of the largest size, or a flat parcel two feet square, the combined length and girth of which would be six feet, which is the limit set by the British Parcel Post regulations. This resulted in a car two feet wide, two feet high and six feet long, inside measurements, with a track gage of sixteen inches. The cars were of the four-wheeled type with a motor mounted over one axle and a compartment over the other which was available for par-

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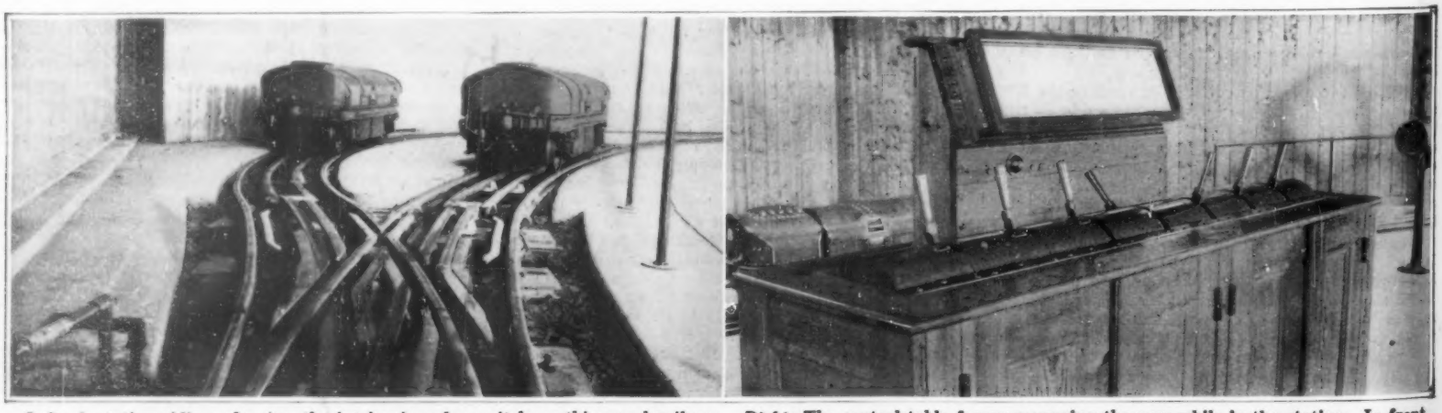


Left: A station siding, showing the intricacies of a switch on this novel railway. *Right:* The control table for maneuvering the cars while in the station. In front of the operator is a diagram of the line upon which the movement of trains in transit is automatically indicated

Molasses for Fuel

By S. R. Winters

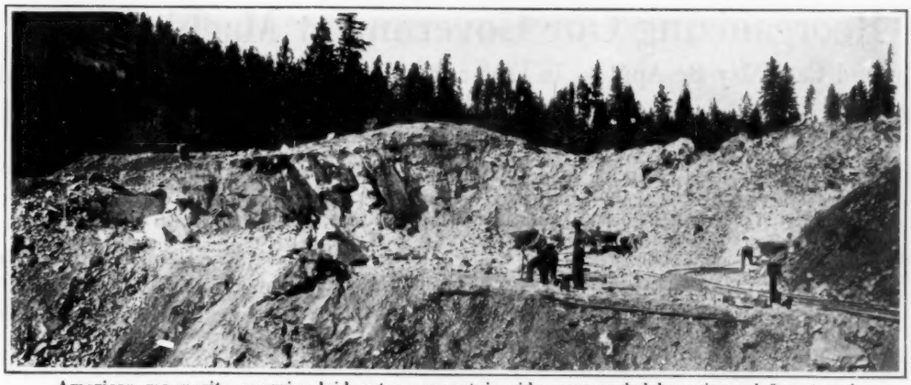
THE United States may not duplicate the embarrassing procedure of Cuba—whereby sugar-manufacturing establishments through the force of economic necessity dump molasses into ditches and subsequently pay a penalty to the government for destroying property; but the urgency of the fuel problem lends emphasis to a new chemical and mechanical process for converting blackstrap molasses into a liquid fuel, with the residuum resolving itself into potash. Credit for the perfection of the formula, details of which are being withheld from the public, belongs to Dr. Paul G. Hildebrandt, formerly of Havana, Cuba, whose experiments were conducted in collaboration with Swarthmore College of Pennsylvania. The inventor has sold his rights to United States basic patents to a group of Philadelphia individuals for $1,550,000, resulting in the formation of a corporation for the manufacture of blackstrap fuel and potash products.

Attempts to utilize low grade molasses as a fuel for half a century have proven unsuccessful; the tardy fruition of such efforts being realized in the newly-discovered chemical and mechanical process, according to claims. The molasses yields in British thermal units a fuel equal to that of coal, and after extracting the heating value from a ton of molasses there is a residuum of from 135 to 150 pounds of commercial potash. Laboratory experiments in Swarthmore College showed a production of 13,000 units of heat from a pound of blackstrap molasses, whereas the choicest pound of bituminous coal in the State of Pennsylvania is said to yield only 13,500 British thermal units. The waste product, after extracting the fuel from the molasses, resolved itself into potash usable as commercial fertilizer by the farmer or for industrial purposes.

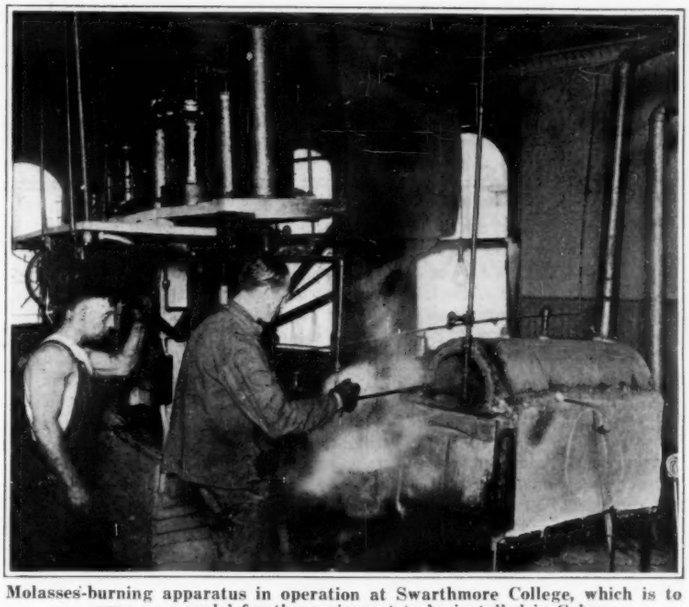
Cuba, as the truthfully described sugar bowl of the world, is to share the benefits of the machinery equipped and installed as models in the laboratories of Swarthmore College. The cost of labor and of fuel insures against the economical operation of sugar-manufacturing plants in Cuba. The latter, as well as other sugar-producing countries, are not so fortunate as to have coal mines and oil wells. Formerly, when sugar exportation was comparatively small, Cuba utilized the fiber from sugar cane and such wood as was available for fuel in the operation of sugar refineries. Today, with the increasing demands of a sweet tooth at home and abroad, Cuba has to look elsewhere for its fuel supply. With coal $13 and even as high as $15 in this country, its exportation to the plantation jungles of interior Cuba naturally exacts a heavy transportation toll.

Blackstrap molasses is a by-product as a resultant of extracting all the sugar from the juices of the cane. Obviously, then, the discovery of a chemical and mechanical process of converting low grade molasses into a liquid fuel at the sugar houses in Cuba facilitates the production of sugar by giving a cheap fuel, available at the mills. At present, the Cuban refineries discard the molasses as waste, pouring it into ditches, and pay a fine to the government as required when fish or other resources are destroyed. The costly operation of sugar-manufacturing establishments in Cuba, due to expensiveness of labor and fuel, has been responsible for a centralization of the business, to wit: with a 24,000-ton production of sugar in 1800 there were 870 factories, while in 1911, with nearly a 2,000,000-ton yield, there were only 168 manufacturing establishments.

Molasses, previous to the enactment of national prohibition, was profitably employed in making liquors. The revenue derived therefrom was diverted into channels for increasing the income of the sugar-cane planter.



American magnesite quarries laid out on mountain side, surrounded by primeval forest and mountain lakes



Molasses-burning apparatus in operation at Swarthmore College, which is to serve as a model for the equipment to be installed in Cuba

Since the enforcement of the prohibition law the value of low grade molasses has been reduced to utter worthliness. Formerly it was exported at prices ranging from two to four cents a gallon, f.o.b. Cuba. Laborers in Cuban sugar houses have been demanding wages ranging from $8 to $12 a day. The process of extracting sugar from cane as now practiced involves the

(*Continued on page 437*)

Revolving tubes in which magnesite is treated in converting it into the numerous commercial forms

American Magnesite

By A. R. Surface

THE extent to which the magnesite industry of the United States has expanded as a result of the war is little appreciated by the average citizen. Before the war this mineral, used so extensively in the steel industry, was imported largely from Austria. Today most of it comes from the Pacific coast and particularly from the State of Washington, in Stevens County.

The Stevens County magnesite quarries are laid out on mountain sides, as shown in accompanying view, surrounded by primeval forest and mountain lakes; they are particularly beautiful and spectacular. At night, because of the huge furnaces and brilliantly lighted grounds, the works can be seen for miles. Day and night shifts are run, the quarries being lighted.

A conservative estimate of the already developed Stevens County deposits puts them at 50,000,000 tons, but much larger deposits are known to exist. In color the magnesite presents many shades; red, pink, gray and white. It is all crystalline, with bright, shiny cleavage faces, varying from the texture of granulated sugar to very coarse crystals. In burning it does not crumble to powder, but dead-burns easily in lumps a foot through, in an ordinary lime kiln. It is quarried in open cuts and is mined at low cost owing to its occurrence in immense beds. There is also little waste in handling and sorting.

That magnesite will soon take its place as an important factor in building conditions in the form of plastic magnesite seems assured. Foreign magnesite would be unable to compete with this new market, even if the tariff did not pass Congress. As a first step to the manufacturing of plastic magnesite which will be used for the manufacturing of flooring and stucco work in building operations, the new kilns will be used. Investigations show that there is now a normal consumption of 100 tons a day of plastic magnesite in the United States, while the demand is growing rapidly. Within a year experts look for the demand to be 200 tons a day with a steady increase.

Plastic magnesite is prepared by a process somewhat similar to the refractory magnesite except that in the furnaces or kilns it is not brought to the same high degree of heat as the refractory rock, the burning being done with very closely controlled temperatures. After the lumps come out of the kiln they are ground to a powder of 200 mesh, which is of the same fineness as cement. The powdered product will be placed in barrels or boxes and shipped out in carload lots to wholesalers. Plastic magnesite has passed the test period in structural work and for some time has been used in fireproof buildings. Magnesite coating offers extreme resistance to cracking, is immune to water or heat and will not contract or expand under any climatic conditions.

Army vs. Navy Ration

ARE sailors larger eaters than soldiers? This is answered in part by the appropriations for subsistence. The army ration cost only 43 cents a day per man; the navy wanted 68, but accepted 60 cents per man. Naval experts urged the higher rate on the ground that better and more varied food was required for sea life than on land. The necessary irregularity in the work day of the sailors has also something to do with their apparent voracious appetites.

Reorganizing Our Government Machinery—I

How Thought and Care May Be Applied In Order to Eliminate Wasted Motion and Duplicated Effort

By C. H. Claudy

NOTHING can be successfully accomplished without a preconceived plan; whether one build a tool shed or a Woolworth Building, a scow or a battleship, draw a diagram or paint a masterpiece, a plan must be the foundation.

But *any* plan will not do; and the plan must be such that when the structure or ship is built, the diagram drawn or the masterpiece painted, it will perform the function for which it was created. In other words, the plan must be logical and properly conceived as well as properly executed.

The plan of reorganization of the United States Government which is usually thought of, and which, because of its constant recurrence in people's minds, has come to be accepted as logical, is the grouping of "similar activities" so that the *manufacture* of the product will be most economically and efficiently accomplished.

The idea is of constant recurrence because it is the business idea, the idea of the world of commerce, the accepted basis of almost all activity. It is the best idea for commerce, business, and civilian activity, because manufacture and use are here things apart. The maker of an automobile, or a typewriter, or a book, or a bale of hay, considers economy of production and lets the buyer worry about economy of use. True, he desires that the user find the product economical, because the manufacturer desires the one-time purchaser to be a second-time purchaser; the theory of profit and loss, of business and commerce enters into his manufacturing ideas, since he must please his customers or lose them. But his fundamental principle is economy of production, that his sale price may be low, that he may sell much, and so make a profit.

The Government is not concerned in profit and loss in the making of anything it uses. It does not carry the mail to make a profit but to promote public welfare. It does not operate a life-saving service for gain, but to protect lives and save property for its citizens. It does not coin money to make a profit, but to serve the business interests of us all. It does not make maps, or provide them, or work out agricultural problems, to make a money profit for the government machine but to make the lives of us all easier, happier, better.

Therefore, to reorganize the disorganized machine as if it were a sick manufacturing business, to consider reorganization merely on a basis of economy of *production*, is fundamentally wrong. The important job before the Congress is not primarily to cut down costs but to promote efficiency. Increased efficiency will cut down costs; first costs cut down with a legislative axe will so decrease efficiency that ultimate costs will rise.

The principle on which the Government in general must be rebuilt, and particularly the principle upon which the scientific activities of the Government must be treated, if chaos is not to result, is this: The important end to be gained is the maximum and most efficient *use* of any product of any Government machine. The product may be material: aircraft, ships, guns, greenback or powder—or intangible: time, information, theory, weather prediction, surveying or light and sound and signals for marines. In either case the principle is the same—economy and efficiency of *use* is to us who pay the bills the important thing. If use can be served while economy of manufacture is also served, well and good. If most efficient use demands a larger manufacturing cost than efficient use with a less cost, then the larger cost is the most economical. This may be plainer with a concrete example.

Much discussion has recently taken place regarding the advisability of the establishment of a Department of Aviation, in which all the Government's aerial activities could be centered. Such a Department would provide planes and aviators for such diverse activities as mapping, exploration, mail-service, army, navy, surveys, life-saving service and transport. It would have jurisdiction over air laws, regulations, landing fields, civilian and amateur flying and manufacture. It would encourage, promote and assist in the development of new ideas—would, in fact, be to aviation what the Department of Agriculture is to the tilling of the soil and the raising of stock.

There is small question but that such a Bureau, if not a Department, will eventually be created, although it may be but a part of a larger Bureau or Department of Transportation. But to take from the Army and the Navy their planes, their aviators, their fields and hangars, would not promote efficiency of use of planes in war. It *would* save money. So would it save money to put all battleships out of commission until a war came along. So would it save money never to hold target practice with fourteen-inch guns. So would it save money to maintain no military establishment in fact, but to have it entirely on paper.

But the ends we wish to serve with our Army and Navy are those of defense, of preparedness for eventualities, of the possession of an expandable and efficient weapon which we pray we may never have to use, but which we want effective if we do have to use it. Unless the profession of arms is allowed to do its own experimenting, develop its own weapons and practice its own men in their operation, it can never rise to the peak of efficiency.

Here is the principle illustrated: The essential thing in reorganization should be the *use*, not the *making*, of the product. Granted that one central factory could make airplanes cheaper than two. Granted that a civilian manufacturer could produce planes quicker and cheaper than either Army or Navy. But can any but Army and Navy produce Army and Navy planes which will be as useful to Army and Navy as those produced in their own shops by Army and Navy?

THE SCIENTIFIC AMERICAN is in thorough agreement with Mr. Claudy as to the need of reorganization of the Government machinery. We believe in the essential soundness of the idea of a Joint Commission of the Congress, which will painstakingly, deliberately and thoroughly investigate the present condition of this machinery, and as soberly and carefully advise as to changes. We believe that no change should be made without a hearing being given to all those who know anything of the bureau or office which is to be changed, of the bureau or office which will absorb the one to be eliminated, and of that portion of the public which is interested in the work of the bureau or office to be changed. We believe that no vitally important piece of engineering can ever be successfully carried out without careful preliminary surveys and far-sighted planning, and so we venture a word of caution: We believe this Government machine of ours far too important, inefficient though it undoubtedly is, to be changed at haphazard, altered without investigation, or rebuilt without careful and deliberate forethought.—THE EDITOR.

There are many cases of duplication of effort and facility in the Government machine which can be, and should be, eliminated; which when eliminated by combination, will make for a greater efficiency of use as well as of manufacture. There are, in the Government, nineteen agencies doing hydraulic construction; fifteen concerned with rivers and harbors; twenty-five working over buildings and grounds, construction and supervision; sixteen doing road construction; twenty-four doing mapping and chart work; fourteen concerned with public lands; sixteen agencies for chemical research; ten offices working with public health; fifteen with education; eleven dealing with foreign commerce; and so on. Doubtless many of these could be, should be, coalesced.

But they should not be combined merely because it *appears* as if they should or because economy of operation *alone* will result.

Congress has created a Joint Commission to study Government reorganization. It will require at least a year and perhaps more, for this Joint Commission to make an exhaustive investigation and a report. In the meantime, well intentioned legislators are doing, or trying to do, curious things with the Government. With the greatest possible respect for all legislators who introduce bills looking to changes in the Government machinery, it must nevertheless be chronicled that if a Joint Commission will require a year or years to find out what should be done, no one Senator or Representative is competent to decide off-hand and in advance that certain changes should be made. There is before the Senate a bill abolishing one and creating two new departments and moving around, like chess men on a board, a large number of Government bureaus. How the learned Senator who introduced this bill knows what he is doing or why, the present writer will not venture to say; he does say, and with emphasis, that in haste lies danger, that it is far, far easier further to disrupt the already worn-out Government machinery than it is to rebuild it, and that one of the great causes of present Governmental inefficiency is hasty and ill-advised legislation.

Another great cause of our Governmental machinery troubles is bureaucracy, politics and personal ambition. To fill a need a certain Bureau is created, with a Chief and a Secretary. The Chief does a good job, the Bureau grows, the Congress authorizes a larger number of clerks, the administration changes, the Chief dies, some one gets John Smith appointed as Chief. The Bureau ceases to be necessary or becomes so nearly allied to another Bureau that it is a practical duplication. Some one suggests its abolishment, or its merging with the other bureau. John Smith, with pride in his job and a desire for his salary "lines up" as many legislators as he can, telling them *his* side of the story, and making them believe in the absolute necessity of the retention of *his* Bureau. The Bureau stays. Inefficiency triumphs. Bureaucracy has its way.

No one in Washington wants to give up his job or his title. The dog wants to swallow the tail and the tail desires to engulf the dog. The greater is always trying to swallow the less; the less is forever trying to become the greater. When some legislator attempts to rearrange Bureaus A and B and C by taking them from their Departments and putting them under a newly-created Department, he probably consults none of them, but as soon as they get wind of the change they are all upon his trail to convince him that A and B and C should be left alone or given the right to absorb the others.

It is submitted that this Government machine of ours is far too important to all of us to be made the sport of bureaucrats or the nail on which legislators, well intentioned but ignorant, hang their publicity-hunting bills. After all, this is *our* Government. *We* pay for it. *We* support it. It is here to serve us *all*. The thing we demand from it is service, first. Give us economy of operation if you can, is our message to Uncle Sam, but give us service. Let us be well governed. What the Government makes, let it be well made, made so that it can be efficiently used.

Carburetor Economy

THAT of every gallon of gasoline used in a motor car nearly 30 per cent is wasted through faulty carburetor adjustment resulting in imperfect combustion, is one of the startling conclusions derived from exhaustive tests of the composition of automobile exhaust gases by three of the prominent chemists of the U. S. Bureau of Mines, working in coöperation with the New York and New Jersey State Bridge and Tunnel Commissions for the purpose of determining engineering facts in connection with the ventilation of vehicular tunnels. The experts who conducted these experiments state that careful carburetor adjustments should result in saving half this amount. They asserted that the great majority of motor cars and trucks are operated on rich mixtures suitable for maximum power but very wasteful from the standpoint of gasoline economy. They said that the average motor car carburetor is set for winter operation and is not changed in summer.

They urged that the public should be impressed with the saving in gasoline resulting from the use of lean mixtures, and suggested the general installation of a small gas sampling tube in the exhaust pipe of motors, especially trucks and vehicles used by taxicab and trucking companies, for the purpose of securing carbon-dioxide determinations, thereby making proper carburetor adjustment possible. They pointed out that such companies could well afford to employ a chemist to make regular control tests, and that the results of such a practice would be great economy in operation.

Correspondence

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.

The Edison Questionnaire

To the Editor of the SCIENTIFIC AMERICAN:

I have been greatly diverted by the newspaper controversy over the test questions that Mr. Edison has submitted to young college graduates, candidates for employment with his company.

It seems to me that the criticisms on both sides have been unfair. In the first place, it is certainly Mr. Edison's own business to adopt whatsoever measure he chooses for the qualifications of his employees, so that I think all criticism of the examinations on the ground of their unreasonableness and unfairness, is quite unjustified. On the other hand, it seems to me that Mr. Edison jumped to a rash conclusion when he stated, if indeed he did so state, that higher education in the United States is a complete failure because most of the candidates failed to answer correctly most of his questions.

The salient characteristic of Mr. Edison's questions is that none of them investigates the candidates' powers of understanding. I say none of them—I have seen two lists of 70-odd questions each, of which the foregoing statement is literally true, and then I have seen some isolated questions having to do with mechanics, of which the same criticism is more or less true because the questions stated contained insufficient data for a solution. One such question is:

A cannon ball weighing 100 pounds is let fall on an anvil two feet below it. What is the force (maximum) of compression in pounds? To have its proper setting, this question should be placed between the two following: 1. How much water will an 18-inch pipe carry? 2. How long is a rope?

Aside from this, however, and on the general grounds of the questions I have seen, I am astonished that Mr. Edison should put so high a premium on the acquisition of miscellaneous information, and so very low a premium on understanding; and I think that therein lies the difference between him and the colleges.

As I understand it, it is not so much the aim of our scientific and engineering colleges to inculcate knowledge of facts as it is their aim to improve the reasoning, understanding and deductive powers of the student; and I think their aim is the correct one. The presumption is that after a young man is graduated from college, he may, without undue effort, learn the port from which most of the washing machines manufactured in the United States happen to hail (and I am not gainsaying that that is an important piece of knowledge); but I think that the young man would have less difficulty in acquiring that knowledge than he would have in learning what is a logarithm. I hold he ought to learn about logarithms first. Knowledge sufficient to answer most of Mr. Edison's questions could readily be acquired by a conscientious study of our Sunday supplements, and I think that the college boys after graduation can be counted upon to apply themselves to those works of reference with great assiduity; but I think none the less, it is inexpedient to concentrate on the Sunday supplements before graduation, and I much prefer the present practice, be the results howsoever lamentable in Mr. Edison's estimation.

I have just jotted down a brief list of questions that I think would fairly canvass the scientific perspective of a new candidate fresh from college, who wants to enter the employ of a great electrician and physicist. I think the candiate who answers them satisfactorily would show a quality of understanding and scientific learning that would be a reasonable earnest of success; but I should not expect the young man of 21 years of age, who answered these questions intelligently, to know what country produces the most attar of roses, or what are the ingredients of printer's ink, and the fact that he did not know such things would not lead me to conclude that he was uneducated or unobservant. On the contrary, I should say that he was vastly more likely to prove a useful member of society than the man who failed in my examination and passed Mr. Edison's. Here are these questions:

1. Who invented the infinitesimal calculus, and what is it?
2. When did Isaac Newton live? State his three laws of motion and the law of gravitation. State them mathematically.
3. Who was Michael Faraday? What contribution did he make to the science of electricity?
4. Who was James Clark Maxwell? What in general was his contribution to electrical research in connection with the work of Faraday?
5. Maxwell summarized Newton's three laws of motion in one brief equation. Write it.
6. What is a quaternion? Who invented them? What good are they?
7. What is a logarithm?
8. What is the base of the natural system of logarithms?
9. Why do you call it the natural system?
10. How many cube roots has unity?
11. What are they?
12. What is a hyperbolic function?
13. What good are they?
14. Why can't you write a formula for the circumference of an ellipse? Or can you?
15. Who was Euclid? When did he live? What was his contribution to geometry? State his famous parallel postulate.
16. Who was Lobachewski? Who was Bolyai? About when did they live? Summarize briefly their work in connection with the parallel postulate, and the effect of their discoveries on the development of thought.
17. What is meant by non-Euclidean Geometry?
18. Who is Michelson? What did his experiments reveal touching the velocity of light?
19. What is simple harmonic motion? Write the equation for it.
20. Define entropy.

The point of this letter is not in any way to criticise Mr. Edison or his examinations, or to propose mine, but to plead that there is a chance for two points of view touching scientific education in our institutions of learning, and to emphasize the danger of drawing general conclusions. Thus, I can conceive that Mr. Edison himself might fail in my examination, and an unthinking person might conclude therefrom that Mr. Edison was totally unfitted to conduct modern research in electricity and physics, which would be unfair. Just so Mr. Edison should remember that a youth prepared to answer my list has very probably spent his time in training his mind, and has not yet begun to stuff it. I am one of those who would rather employ a trained mind than a stuffed one, on the general ground that it is easier to stuff than to train. Parenthetically, I am not very keen about Mr. Edison's stuffing either. However, the point is that I happen to have the collegiate point of view and Mr. Edison holds the opposite point of view, and it is important that the holders of each point of view should recognize the existence of the other.

DEWITT D. BARBER.

New York.

The Coal Pipe-Line

To the Editor of the SCIENTIFIC AMERICAN:

In your issue of Feb. 12th you publish a proposed scheme for transporting coal through pipes from the mine to the seaboard.

This very same scheme was proposed by the undersigned in Feb., 1918, in this country. I tried to obtain a patent from the Peruvian Government, but two local engineers, friends of mine, unluckily of the same profession, called upon to report on my scheme, knocked it down because such transportation was carried out for short distances, hence there was no novelty in applying it for long distances.

Coal is very abundant in the interior of Peru—but this interior is between 10,000 and 16,000 feet above the level of the sea and the country between is very rough, so much so that railroad lines cost $25,000 to $50,000 per mile. Interest and amortization on a 50-mile line required would be so heavy that the coal placed on the coast could not compete in price with the imported coal.

The strike of the coal seams is about north 40 west on both slopes of the main range of the Andes and the seams on the western slope are cut by streams at right angles that reach the coast. There are several coal regions known to me where conditions are ideal for the proposed scheme: *i.e.*, abundant good coal, comparatively straight valley to the coast, lots of water and difference in level from 10 to 16 thousand feet.

Although coal is so abundant in the interior, Peruvian coal is not known in Lima or the coast and it would be a great surprise to 99 per cent of the inhabitants to know that good coal could be obtained in any quantity were it possible to transport it cheaply.

The average price of coal before the war was 20 sols ($10 U. S. gold) per ton; during the war and now it is some 170 sols ($35 gold). I calculate that with a capital outlay of some $500,000 for coal mines, pipe line, etc., I could place on the seaboard 1,000 tons per day at a maximum cost of 15 sols per ton, all expenses included.

If the scheme is feasible in the States where cheap railroads, canals, etc., abound, where the coal and freights are cheap, much more will it be here where the lowest freight for coal is 3.5 centavos local money per ton-mile, where the railroad line would be nearly exclusively for coal transportation, hence the empty cars would have to be hauled back, where the railroad lines themselves are very expensive and lastly where the coal is very dear on the coast and to be had for nothing in the interior and where no pumping would be necessary.

Say that but 1,000 tons were transported 300 days in the year and that these were sold in the form of coal dust, briquets, coke or powder and that the average product was but 25 sols per ton; this with a capital outlay of some one million sols.

R. F. LETTS.

Lima, Peru.

Spark Plugs

To the Editor of the SCIENTIFIC AMERICAN:

I beg to differ with the author of the article "Spark Plug Location Important" in your issue of March 19. He says "a plug that becomes heated will tend to soot up and carbonize," etc. It has been my experience that the contrary is true. I have been in the repair business for eight years and have come in contact with all makes of cars. It is true that in racing cars the cooling of the plug is an important item, but not one car in a thousand is subjected to the continuous heat which is developed in racing.

I have seen aggravated (and likewise aggravating) plug trouble in No. 1 cylinder of several four-cylinder cars (anyone who has had experience with them knows what that is) cured by the simple expedient of placing a ½-inch close nipple and pipe coupling in the spark plug hole and screwing the plug in the coupling, thus raising the plug about two inches above the cylinder head where it loses the cooling effect of the water jacket. I know the plug becomes hotter because the same plug that fouled was replaced after cleaning the porcelain and the discoloration of the shell noted due to the increased heat.

There is at present on the market a device which takes the place of the pipe fittings and is sold in combination with a certain spark plug which is guaranteed not to carbonize, but they do not use the above reason for the non-carbonizing as a selling argument.

Also there is manufactured in Newark a spark plug with a corrugated porcelain which protrudes beyond the plug shell into the explosion chamber, the effect being that the porcelain becomes so heated that the carbon does not deposit on it. At the same time I have seen the shell, which is in contact with the water jacket, coated with an eighth-inch carbon deposit. So I believe the theory is correct. The only requirements are electrodes that will not burn away and a porcelain which will stand the increased heat. At the same time these plugs might not be satisfactory in a racing car or airplane motor. We have used several dozen of them with great success in different types of motors.

Irvington, N. Y. L. W. SMITH.

A Biological Insurgent

To the Editor of the SCIENTIFIC AMERICAN:

May I use a little of your space to attack the popular mutation theory. I take it that the belief of the mutationists is, that the prime cause of the evolution of species has been the sudden production of large departures from the normal. Now it is my belief that not only mutations but many of the minor variations that we observe in plants and animals are by no means original; but are "throwbacks" to types that have otherwise become extinct.

A mutation then is the result of either the accumulation of slight variations or of the inheritance of acquired characteristics or both.

Every dog breeder knows that an apparently pure stock will occasionally produce what he terms a "throwback" which is breedable, while the appearance of idiots among human beings is another example of the same thing. Take the historical case of the Scon sheep, a breed which arose from a single short-legged ram, born of normal parents on a New Hampshire farm. Without doubt some of the remote ancestors of this famous ram were short legged also, but short leggedness being no great advantage in those days they had failed to survive. This time they survived because the farmer saw an advantage in a sheep that could not jump a fence.

So that this peculiar ability of a type to lie low and to come to the surface at ever increasing intervals (a principle that might be called the suppression of the unadapted) has no doubt played an important part in the evolutionary scheme.

H. J. SMITH.

Toronto, Canada.

Super-Speed Propellers

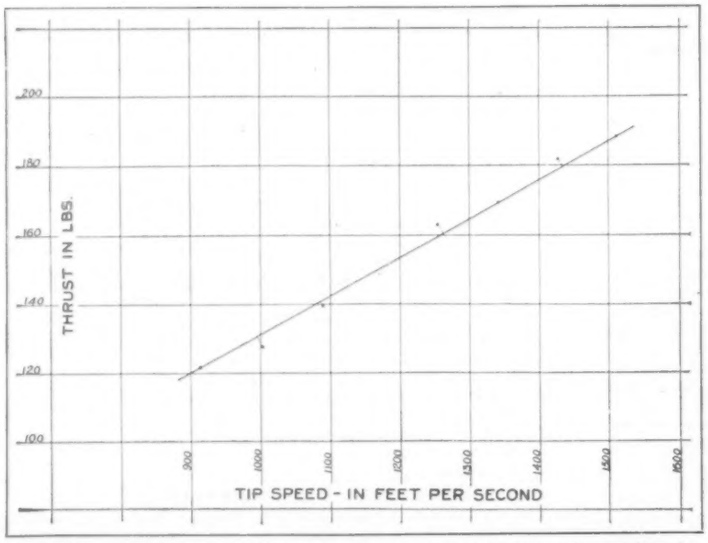
Air Propellers With Blade Tip Velocity Above That of Sound

AIR propellers are rarely driven with a tip speed even as high as 950 feet per second, and there has been a view current among aeronautical engineers that a critical point exists at or near the velocity of sound, say, 1,100 feet per second, which would act as a physical limit and beyond which there would occur something like what is known with marine propellers as cavitation. Apparently the only published attempts to explore the region of higher speeds are those which appeared in a paper issued March, 1919, by the British Advisory Committee for Aeronautics, in which a tip speed of 1,180 feet per second was reached with a two-blade nine-foot propeller, when the observation was made that "as the tip speed approaches the velocity of sound the usual air flow entirely breaks down, the slip stream rapidly diminishes, and ultimately vanishes when the velocity of sound is reached. Air then appears to be sucked in on both sides of the disk and exhausted at or close behind the periphery; presumably the thrust of the screw under such conditions becomes exceedingly small and may possibly vanish."

Mr. S. Albert Reed, Ph.D., a retired engineer, while engaged in 1915 in private research work on acoustic pitch of high frequency, employed an apparatus which had a shaft rotating at over 600 revolutions per second, carrying a hub with radiating arms of thin metal with sharp edges. He observed that centrifugal force supplied the necessary rigidity to the arms. It then occurred to him that the field of high speeds for air propellers might be explored by a similar method and he proceeded to conduct, systematically, a long series of experiments with propellers 20 inches in length. He used a 10-horsepower electric motor of 1,150 r.p.m. geared up 12¼ to 1 to the propeller shaft, which therefore rotated at 235 r.p.s. The apparatus was carefully designed to permit accurate measurements of thrust, torque and speed, and he ascertained that the supposed physical limit at the velocity of sound does not exist, but that in fact the ratio of thrust to tip speed undergoes no appreciable variation in passing through that velocity. This result was obtained up to a velocity of nearly 1,600 feet per second, beyond which he did not continue his researches for the time being. Mr. Reed then had his models and testing apparatus reproduced on a working scale capable of absorbing 100 horsepower, at the factory of the Curtiss Airplane & Motor Corporation, at Garden City, L. I., and Mr. Gilmore, Chief Engineer, placed the tests in charge of their Director of Research, Mr. Arthur L. Thurston, under Mr. Reed's direction.

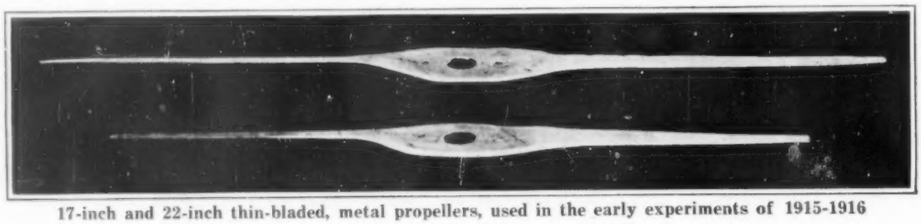
The Curtiss engineers found Mr. Reed's laboratory results fully verified, and the accompanying plot and photograph illustrate the test made April 6, 1921, with the 4-foot propeller seen in the cut and which reached a tip speed of 1,508 feet per second with a thrust of 186 pounds. This is 36 per cent beyond the velocity of sound and is something between the speed of a revolver bullet and that of a rifle bullet.

The formula for centrifugal force, if applied, will show that with a propeller of 2 feet radius and a peripheral speed of 1,000 feet per second, 1 ounce will give a radial tension of about 1,000 pounds, and at 1,500 feet per second, about 1 ton. It is evident that a virtual or kinetic rigidity is thus supplied, which may sufficiently replace the structural rigidity of the usual air propeller and make possible a blade sufficiently thin and sharp to function properly at these enormous speeds.



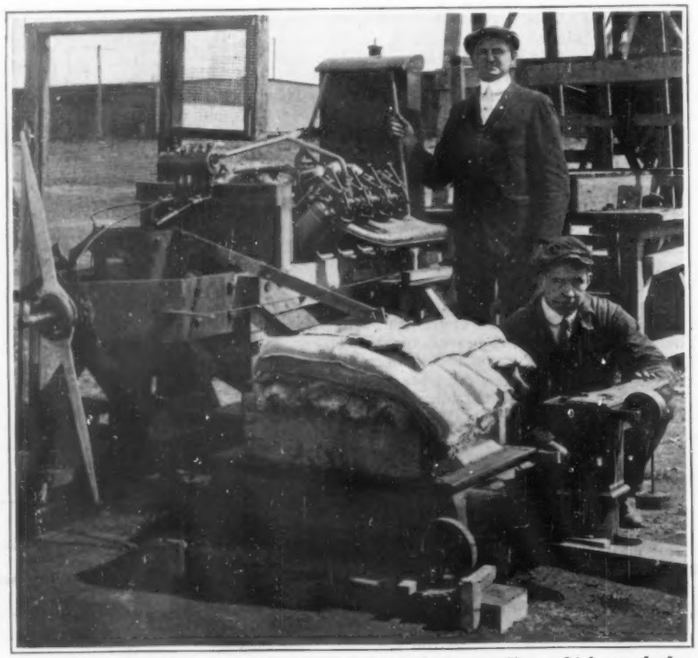
Graph, showing results of test of Reed's thin-bladed high-speed propeller, in which there was a steady increase of thrust as the blade-tip speed rose from 900 to over 1500 feet per second

At the ordinary speed of about 600 feet per second, the usual rather bulky and blunt propellers sufficiently meet the conditions; but apparently they are not adapted to the super-speeds, which may be placed as beginning at about 850 feet per second.



17-inch and 22-inch thin-bladed, metal propellers, used in the early experiments of 1915-1916

In order to ascertain the efficiency of this type of propeller for actual flying the experiment illustrated in the cuts was repeated under approximately wind tunnel conditions, the wind being supplied by an airplane anchored close in front of the Reed propeller and delivering its slip stream axially down the slip stream of the Reed propellers, the wind velocity being carefully plotted with a Pitot tube, at about 42 miles per hour.



Test at Curtiss plant, April 6th, 1921, of a 4-foot propeller, which reached a tip speed of 1508 feet per second, with a thrust of 186 pounds

The efficiency factors so determined were found to be high, and a 9-foot propeller of the same design is now nearly ready for testing without gear on an airplane, and both on the ground and flying.

Mr. Reed has prepared a paper for one of the scientific societies, giving the details of his researches quite fully, and it will be published in the near future; but there appears to be no doubt that his researches have opened up the field of super-speeds for air propellers, and have proved the non-existence of the supposed physical limit which has to some extent deterred engineers in the design of propellers intended to absorb the horsepower of the very high powered motors. Furthermore, he has opened up interesting possibilities of use with the steam turbine, which operates with extremely high rates of shaft rotation.

Mr. Reed informs us that his results will be covered by U. S. and foreign patents.

British Power-Alcohol Research

IT is reported that detailed research is shortly to be undertaken in India with a view to determining the practicability of producing power alcohol on a commercial basis. Rice straw and other cheap raw materials which are said to be available in abundance will be used for the purpose of the investigations. Should these experiments in India prove successful, they will be followed by similar undertakings in various other parts of the British Empire.

At the same time that these experiments are being conducted, efforts are being made in Great Britain to make possible the ready use of such a substitute fuel whenever it becomes available in sufficient quantities. With this object in view, the Empire Motor Fuels Committee of the Imperial Motor Transport Council has recently appointed small technical committees to consider specifically:

(1) The modification of customs and excise regulations pertaining to alcohol;

(2) Experiments for determining the best conditions for developing the alcohol; engine, and types of alcohol fuels, alone or in mixture, for industrial purposes; and

(3) The denaturing of alcohol; *i.e.*, rendering it unpotable.

The problem of ascertaining what is a suitable denaturant is regarded as of very great importance, and the Empire Motor Fuels Committee (50 Pall Mall, London, S. W., 1) has invited in confidence interested members of the public to submit practical suggestions as to possible denaturants. Such proposals will remain the sole property of the individual who furnishes them, and his interests will be properly safeguarded. The special requirements of a satisfactory denaturant, according to the committee, are (1) deterrent taste and smell; (2) non-poisonous; (3) must not be removable at a commercial cost; (4) must be readily detectable in small quantities; (5) must be readily mixable with the spirit; and (6) must be inexpensive.

This affords an excellent opportunity for the practical chemist, albeit it is not such a simple problem as it seems at first reading.

A Multiple Feeder for the Thresher

AN improved type of self-feeder for the grain thresher is shown in the accompanying illustration, which stands for less work for the pitchers and consequently reduces the number of men necessary to keep the machine going. Instead of one long extension feeder running out between the grain stacks or the bundle wagons, two or more short feeders, that can be adjusted as to height and position, are employed. When threshing bundles from the field it is not necessary to drive so close to the machine, and when threshing stacked grain, the feeders can be adjusted to swing out over the stacks and save steps for the pitchers.

Wing type of self-feeder for the grain thresher, which saves the labor of a number of farm laborers wherever introduced

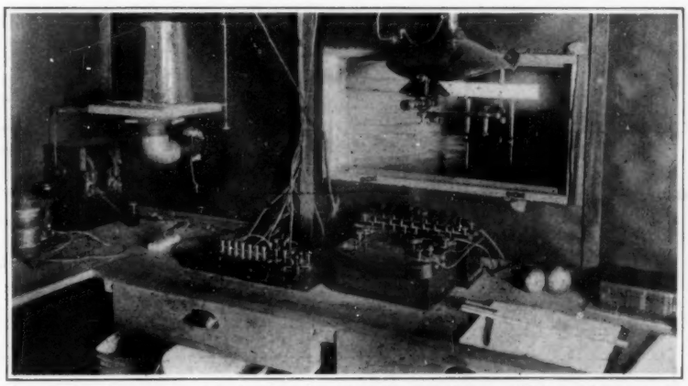
Artificial Frost for Testing Fruit

ANNUALLY, hundreds of carloads of apples, potatoes, citrus fruits, and other products of field and orchard spoil from exposure to freezing temperatures. To determine the points at which small fruits and vegetables can be shipped or stored without being liable to injury, the Horticultural and Pomological Investigations, United States Department of Agriculture, at the Arlington, Va., farm, is employing the electrical method of analysis. Frost injury is likewise included in the scientific study.

By an apparatus equipped by George F. Taylor, Government scientist, twelve freezing determinations are obtained simultaneously, the rapid-fire instruments registering a change in temperature of 1/20 degree within 1/100 of a second. Of course, the reading cannot be accomplished with such lightning-like rapidity. The equipment proper consists of a brine-cooled freezing tank to which are attached 12 cups into which various units of fruits or vegetables may be suspended for making determinations as to freezing. Measurements, ranging from 24 to 72, depending on the character of the products, are made with a potentiometer.

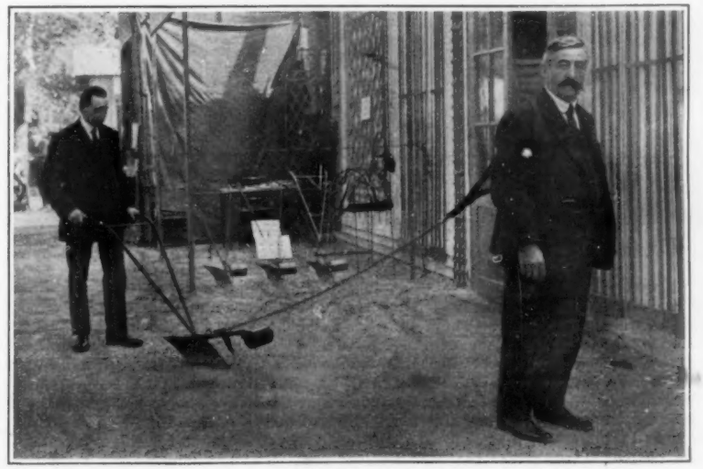
Novel in the Government study of the freezing points of fruits and vegetables is the method of making thermocouples, these being of small size, well insulated, durable, and having a very little lag. The couples are made from silk insulated copper and constantin wire. As many lengths of each kind of wire as there are to be junctions are cut, about a meter long, assembled together, each end of the bundle slipped through a small, hard glass tube. The ends of the wire are dipped in bakelite to cement the insulation solidly, dried, the insulation burned away for one centimeter, the ends scraped bright and twisted together in pairs, a copper and constantin wire to each pair, for 3 millimeters of the length. The couple is then insulated with glass by placing a very small soda glass tube over it and heating in a small flame, the silk covering above the junction being protected. At a cherry-red heat the glass softens, and shapes itself to the junction, being completely insulated. A like treatment produces the other end of the couple. The diameter is so limited that the multiple-junction couples can be used with smallest fruits with ease, a fifty-junction thermocouple of No. 40 wire being only 2.5 millimeters in diameter.

The temperature is measured by determining the drop in the potential between one terminal maintained in a constant temperature (ice bath), and the other terminal of the unknown temperature in the freezing tank. Twelve readings are made at the same time, the fineness of the measurements being within one ten-thousandth of a degree. The investigations have the threefold purpose of determining the temperature points at which frost injuries occur, devising ways of salvaging injured produce, and methods of protecting fruits and vegetables from damages sustained by low temperatures.



Apparatus for measuring twelve freezing temperatures. Note galvanometer in upper right-hand corner, and potentiometer and selector switches in center

Canvas bag employed in gassing citrus fruit trees and designed so that the gas does not reach the workmen



Man-drawn plow now being used in France for farming and gardening on a small scale

Water Solubility a Necessary Property of Wood Preservatives

THAT any substance to be an effective wood preservative must be soluble in water at least to the extent of producing a toxic water solution is the basis of a theory now being developed at the U. S. Forest Products Laboratory. It would seem reasonable to expect that any material which is poisonous enough to kill an organism of any kind must necessarily be soluble in the body fluids of that organism; and the chief body fluid of timber-destroying fungi and wood borers is water. With very poisonous materials this solubility need not be great; in fact, 1 part in 1,000,000 may be sufficient if the material is poisonous enough.

Wood preservatives now in use are of two distinct types—inorganic salts, such as zinc chloride, which are very soluble in water; and oils, such as the creosotes, which are generally considered to be insoluble. The solubility of creosote is usually considered so slight as to be neglected, but experiments indicate that certain constituents of creosote are sufficiently soluble in water to make it poisonous for wood destroyers. Creosote oil may, therefore, be considered as consisting of two groups of compounds, one of these being sufficiently soluble in water to render it toxic, the other insoluble in water and hence not toxic. The non-toxic oils act as a reservoir for the toxic oils and feed them slowly to the moisture in the wood.

The difference between oil preservatives and inorganic salt preservatives, as far as this theory is concerned, is in their method of retaining the reserve supply of poison. Zinc chloride has no reserve supply, all the material being soluble in the usual amount of moisture present in air-dry wood. Sodium fluoride may have a reserve supply in the form of solid crystals, if applied in a saturated solution. Creosote oil may have a considerable reserve supply stored in the oil itself, this supply being fed to the wood as needed.

A Gas Attack on Destructive Bugs

THE deadly fumes of hydrocyanic acid gas are used in eradicating objectionable bugs and fungi from citrus fruit trees. As a couple of whiffs of this gas spell sure death to the workmen, great care has to be exercised in treating the trees. A graduated scale is so painted on the outside of the canvas bag that is employed for the administering of the gas, and that forms the subject of the accompanying view, as to indicate how much gas is required for any given tree. As the canvas bag is placed over a tree, the graduated scale indicates the size of the tree; and by subsequent reference to the poison record on the automatic engine which makes and distributes the gas, the attendant can accurately determine exactly how much poison gas to give each tree. The treatment occurs in the late afternoon and the canvas bag is wrapped around each tree in turn for a period of forty minutes, which is considered ample time to gas the undesirable bugs and growths.

Man-Drawn Plow Work for the Horseless Farmer

THE small truck farmer or gardener can ill afford to employ a horse-drawn plow for preparing his ground, while the use of a spade represents a long and tedious task. To the end of simplifying tilling on a small scale, there has recently appeared in France a small man-drawn plow which is depicted in the accompanying illustration. A suitable form of harness goes about the arms and shoulders of the man who is to do the pulling of the plow. The plow, on the other hand, is so designed that it passes through the soil but a few inches below the surface, the proper distance being maintained by the little roller in front of the blades.

The Roger Bacon Manuscript

What It Looks Like, and a Discussion of the Probabilities of Decipherment

TRAVELING through Europe in search of old manuscripts in 1912, Mr. Wilfrid Voynich unearthed in a nameless castle of France or Italy an unusual collection, formed by the Dukes of Parma during the eighteenth century and then hidden away for safety's sake, and forgotten. He will not tell us where he came upon these treasures, for while he brought some of them away with him, he left still more, and he hopes some day to go back for these. Among those which he secured on his first trip was the so-called Roger Bacon manuscript which has been so much in the public eye since the Philadelphia lectures announcing its existence.

The history of this document as reconstructed by Mr. Voynich, and the efforts to decipher it made by Professor Newbold, are fully recounted in the SCIENTIFIC AMERICAN MONTHLY for June. As is there stated, while it is hardly possible as yet to prove scientifically that the scribe was really Roger Bacon, the very facts the the script is a cipher, that the subject dealt with is certainly of a scientific or pseudo-scientific nature, and that the work may with certainty be dated in the 1300's, suffice to indicate strongly the Baconian origin; while Mr. Voynich has succeeded in showing an altogether plausible line of descent for the manuscript and one which would carry it from Oxford to Prag and then to Parma.

Our purpose here is not to repeat the historical discussion, or to describe or comment upon the cipher as Professor Newbold claims to have uncovered it. We may repeat the opinion set forth by Mr. Bird in the MONTHLY, that the evidence in favor of the alleged decipherment is altogether too tenuous to support the claim that the scribe could really have used such an extraordinary and irrational cipher. We do not look with patience upon a cipher in the preparation or unraveling of which an arbitrary element enters; and there is no suggestion that this arbitrary element would be rendered systematic by knowledge of a key word or key process. But aside from all this, the manuscript is of very great interest, since its Baconian origin rests upon much better ground than the alleged decipherment. We therefore supplement the account of it in the MONTHLY with a physical description of the volume itself.

The work is on vellum, bound together crudely; aside from a certain amount of dog-earing and the inevitable fading of the text, it is in admirable condition, and with the aid of the photostat is readily legible. It is obviously a cipher, containing in addition to the ordinary Roman characters a good many other symbols more or less like letters but without direct significance in any language. Every page is illustrated, in colors of considerable variety. These pictures are crudely drawn in by a person who obviously was somewhat lacking in artistic ability, even for a thirteenth century scribe. There is running text on most of the pages, and in addition a good deal of textual matter so positioned with reference to the drawings that it obviously plays in a general way the part of what modern practice knows as captions.

The drawings are of two general sorts. A number of the pages are adorned with pictures which are plainly of an astronomical or astrological nature. Even if we had no knowledge of thirteenth century tendencies, we should have no difficulty in intrepreting the astrological features as greatly in excess of the purely astronomical. Signs of the zodiac and similar appurtenances abound. But these are not usually to be found in the customary arrangement, and much of the astronomical material is actually got up in a form that makes its significance altogether baffling. An excellent example

Copyright, Wilfrid M. Voynich

A page of the Bacon manuscript which it is fairly clear deals in some way with plant reproduction

of this is to be seen in the right-hand page of the double sheet which we show on the opening page of this issue. There appears to be here a central sun; but in place of the twelve divisions into which we should expect the surrounding space to be laid out, we find seventeen. The zodiacal signs are absent, and we have plain stars, from one to four in each compartment.

Two of the astronomical pages are of extreme interest in that it is on them that the claims made for the validity of the decipherment rest. The left-hand page which we show beside the one just described is not necessarily, on its face, of astronomical character, becoming so with certainty only when we accept the translation of the caption to the central drawing, which is stated to be an account of the scribe's observation of an annular eclipse on a given date of the thirteenth century. On this date, astronomical computation tells us, there occurred such an eclipse; and with this amount of temptation before us, we can concede that the central drawing might represent an annular eclipse. As a matter of fact, throughout the book the artist has allowed symbolism to run riot, and there is in no case any satisfactory way of determining just where he means the symbolism to halt and the objective representation to begin. If we make allowance for this, there is no good reason to refuse recognition to this picture as representing the rim of the sun peeping out around the lunar disk.

On another page appears a central drawing which several astronomers have easily recognized as bearing adequate resemblance to a spiral nebula—always, of course, making proper allowance for the peculiar style of the artist. The text as deciphered tells us that the scribe looked through a refracting mirror—that is to say, a thirteenth century telescope—and saw stars arranged in a pattern like a snail shell, at a point in the heavens which is identified by reference to the girdle of Andromeda and the navel of Pegasus. We do not today show on our star maps the full classical outlines of the constellations, and so the navel and the girdle have to be translated into modern terms before we can plot them; but when we do this we find that the scribe has made a very tolerable approximation to the position of the great nebula of Andromeda. To be sure, this doesn't look much like a snail shell, but we may leave that point to be discussed in the MONTHLY.

It goes without saying that many persons will be convinced by these two items. That they are not necessarily conclusive is we believe sufficiently set forth in the article in the current MONTHLY, and we shall not duplicate this argument here. It is on the basis of the nebula observation that credit is claimed for Bacon for having "invented" or "used" the telescope; sometimes we see one word and sometimes the other. That he was acquainted with the optical principles of the telescope in an empirical fashion is clear enough without this manuscript; that he invented or even used one is hardly clear even with it. Certainly he did not invent it, for in his open works he describes it with the statement that he owes his knowledge of it to others. The bald statement that he invented it appears in keeping with the reckless manner in which this manuscript has been promulgated.

Apart from the astronomical pictures, the bulk of the manuscript is given over to drawings which appear to be of a biological nature. The artist seems to be interested in the processes of life reproduction, and to be depicting these under a heavy cloak of symbolic representation. Where his subject is animal life, without

(Continued on page 439)

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Arts

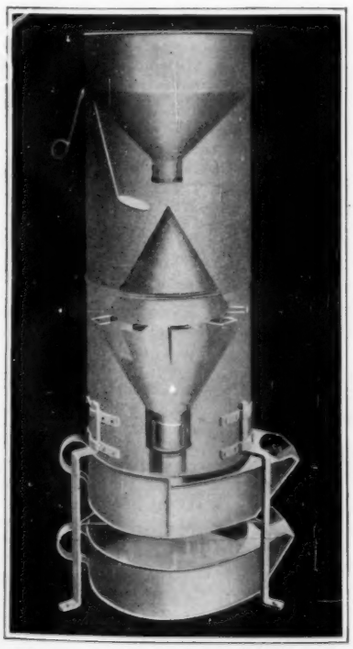
Testing the hardness of a steel twist drill by means of the new hardness tester

A Direct-Reading Hardness Testing Machine

UNLIKE testing machines where the diameter of impression of a certain sized ball is measured after removing the piece being tested to a microscope, the instrument shown above and developed by a New York concern gives the measurement directly on a dial. It is intended for use in determining the hardness of steel, brass, copper and some harder alloys.

This machine measures the depth of impression of a 1/16-in.-diameter ball upon applying a known load to a ball penetrator. The size of the ball is such that it is possible to test wire of small diameters also. And the light impressing load permits outer surfaces of small tubes having walls as thin as 1/32 inch to be tested without placing a mandrel through the tube.

By turning the handwheel the initial pressure is applied until indicator shows pressure is being applied. This makes it certain that the test piece is held to a firm seating and the ball breaks through dirt, scale or other superficial matter. The indicator is made to register zero at this point and the major load is released by pressing a push button at the base of the machine. When the load is withdrawn the initial pressure is left and the indicator shows the depth of impression made by the major load.



Phantom view of home-made grain sampler designed by the Department of Agriculture

The Home-Made Grain Sampler

CONSULT the tinsmith about the availability of a block of tin or brass and construct your own grain sampling device—if you have need for one. A design for such a home-made equipment has been patented by the U. S. Department of Agriculture, the model being dedicated to the use of the public.

The hopper-like instrument is so built that a sample of grain, to be applied in grading a specified lot, can be evenly divided, one-half of which specimen can be used as representative of the whole original sample. Formerly the sample of a specified lot or shipment of grain was obtained by means of a probe, the specimen being divided into smaller portions for one or more of the tests to be applied in determining its classification. This method was considered haphazard in the reduction of the size of the sample and unreliable as to results.

The newly-designed grain sampler is 30 inches high, cylindrical in shape. The specimen of grain is poured into a hopper at the top, the emptying of which is accomplished by pulling a lever that removes a cap over the lower end of the hopper. As the sample flows downward it strikes the apex of a baffle, in the form of a cone.

Encircling the base of this cone are a series of tiny chutes whose distance apart is equal to the width of these openings. Half of the grain empties into the chutes, while half passes between them. The latter portion flows directly into the uppermost of two pans, placed one above the other at the base of the sampler. The half falling into the chutes is diverted into a funnel, the lower end of which leads to a protected opening in the center of the upper pan, thereby permitting this half of the grain to pass into the lower pan. Thus the original specimen is equally divided into two parts, one of which is as representative of the original lot as the other.

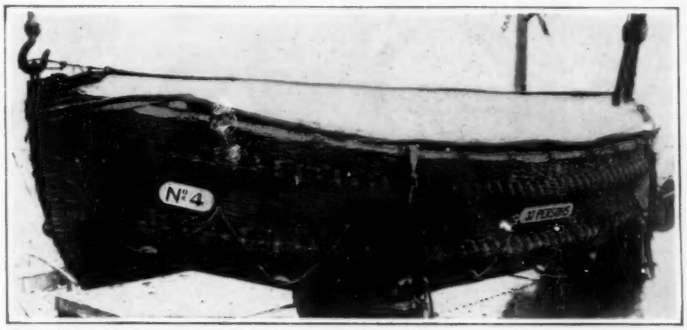
Farmers, millers and grain dealers will find this inexpensive apparatus practical for grain grading. The Government is thus endeavoring to popularize Federal grain standards, having previously issued instructions on weighing, moisture determination and the separation of foreign material in grain.—*S. R. Winters.*

A Simple Aid to Penmanship

THERE has recently appeared among the many devices and works intended to simplify the acquiring of education, a simple aid to penmanship. This device consists of aluminum strips any one of which may be fastened on the edge of a loose piece of paper or the leaves of a blank book, and containing recessed small letters, capital letters or numbers. The idea is to have the student trace each letter or numeral with a pencil until a free and easy swing is acquired, and then to shift over on to the paper and write the same letter or numeral until proficiency is gained. It is claimed this device has proved quite helpful wherever it has been introduced.

Something New in Lifeboats

THE perfecting of the lifeboat and the means for launching it is certainly a fruitful field of invention. On the score of novelty we do not remember anything quite so striking as this so-called "basket-work" ship's lifeboat which was designed by Mr. DeVos of Rotterdam. The method of securing additional flotation is decidedly novel and should be effective against complete sinking. First a skin of cork is laid on the boat, and over this an outer skin of woven cane. Mr. DeVos claims that this type of lifeboat is less liable to be crushed should it be swung against the ship's side. The resiliency of the cane and cork sheathing should give it a resistance to general damage which will add greatly to its chance of surviving the hazards of shipwreck.



This lifeboat, provided with a skin of cork and an outer skin of woven cane, is claimed to be safer than the usual construction

A Safe Traffic Signal that is Never in the Way

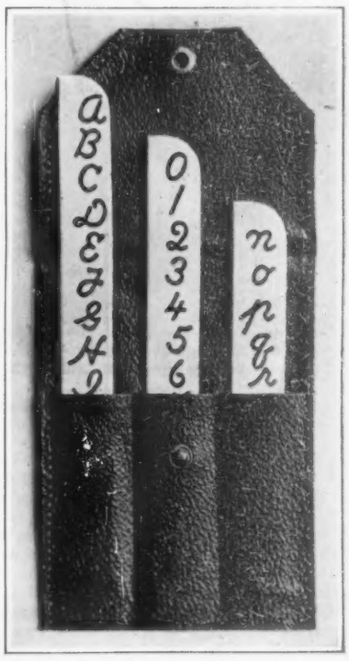
A NOVEL street traffic signal, shown in the accompanying illustration, was designed to replace the tall, unsightly guide posts which still deface many town and small city streets throughout America. Judging by the popularity of the new signal with those motorists who have seen the system in operation at Salina, Kan., it is destined to occupy an important place in the motor traffic regulations within the next few years.

The construction is very simple—180 pounds of concrete molded into a mound two feet in diameter and scarcely seven inches above the street's level at the crown of the signal. The white and black sectors painted on the mound render it conspicuous by daylight, and the red lenses placed at right angles so as to face each street from the signal are warning sufficient for night motorists. The top of the mound has a square white lens deeply counter-sunk, as are the red lenses in the side.

One electric bulb furnishes ample light for all five lenses. This is made possible through the use of a metal tunnel which leads from the bulb cavity to each of the red lenses. If the bulb burns out, it may be replaced in a few minutes by lifting out the white lens in the top of the mound.

A car may turn a bit short and graze the signal, but there is absolutely no danger of an accident which would bring injury to either the signal, car or driver. In reality, drivers are inclined to observe the "guide" more conscientiously than they have done with the "tombstone" type.

The invention of the signal is attributed to E. Buchanan, the Street Commissioner of Salina, Kan., in which town it is now in general use.



Three of the penmanship strips contained in a compact pocketbook

Concrete mound fitted with colored lenses and lights for traffic signals

Top of the shock-absorbing invalid crutch and the sliding tip at the end of the leg

Applying Shock-Absorbers to the Invalids' Crutch

IT has remained for Charles O. Mitchel of Hoboken, N. J., to invent a simple form of invalid-crutch that is provided with a shock-absorber to the end that it will afford elastic support to the user and particularly to his shoulder and arm, thus eliminating the shock incident to impact of the crutch with the ground. This device is claimed to reduce materially the fatigue which rigid crutches are well known to cause. A further object is to provide a yielding crutch which may be manufactured at minimum cost and yet possess strength and durability, notwithstanding the fact that it contains moving parts.

The manner in which this inventor has accomplished the shock-absorbing feature is shown in the two accompanying illustrations. The top of the crutch is provided with a sliding top member, as may be noted in the first illustration. This member can be pressed down against two simple springs that cross each other, while simple chains prevent the movable member from being pushed up too far by the springs. The end of the crutch leg is provided with a sliding tip, which presses against a helical spring. Thus the shocks are taken up at two points. We have seen many crutches with springs, moving parts, and other means to get away from rigidity and shock, but this impresses us as the best device of the sort yet exhibited to us.

Speeding Up the Shaping of Masts and Spars

THE work of making masts and spars for all classes of vessels appears to have been simplified and materially reduced in cost by an ingenious invention credited to C. H. Sawyer of Savannah, Ga. This invention is in the form of a heavy machine shown in the accompanying illustration, which does away with hand labor and turns out a mast or spar in record time. Indeed, an ordinary 100-foot mast, 22 inches at the butt, which would require the labor of one man for fully twenty days to complete by present methods, was recently turned out by the Sawyer machine, with all the necessary cuttings for fittings, in less than three hours.

The mast and spar shaping machine is known as a rotating plane. It is a cross between a lathe and a planer, consisting of a steady rest which grips the stick in the center and rotates it by means of an internal gear driven by a 25-horsepower motor, two carriages that carry the cutting knives, and two tail stocks which support the stick at either end. The speed of the steady rest is considerable, while the carriages which hold the cutting blades are propelled from either end toward the center by a track and trolley arrangement at a speed of three, six or twelve lineal feet per minute. The knives are two in number, each eight inches long but with a cutting surface of only three inches. The accompanying photograph shows the machine in operation.

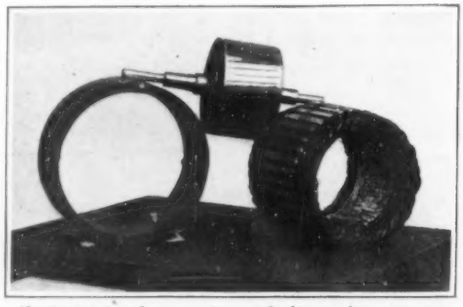
Simplifying the Winding of Small Motors

AN invention, recently patented by Alexander Zarky of Los Angeles, Cal., simplifies the winding of small alternating current motors during their manufacture and even extends their usefulness indefinitely, since it permits of easy rewinding.

The invention consists of a removable core in place of the present type of one-piece core which cannot be rewound because of its inaccessibility. When this new style core is removed the work may be done expeditiously and in the same manner as is customary with direct current machines, and with preinsulated form-wound coils instead of by hand process.

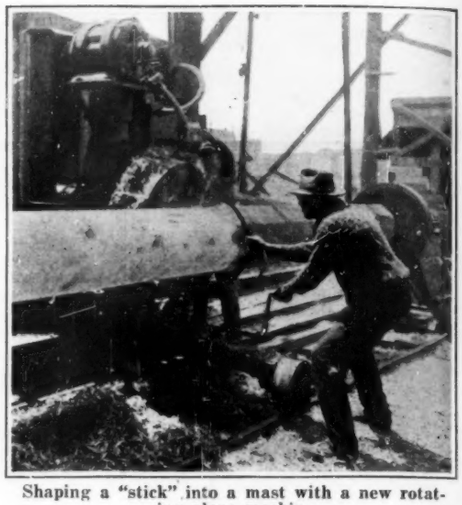
There is a small loss in efficiency where the two cores fit, but the addition of iron at the bridge of the gap in the channel more than covers this, and the prolonged life of the motor because of its rewinding far offsets the slight decrease in current.

The new type reduces labor cost in original construction, but its chief value lies in its applicability to small or fractional power units.



Components of a new type of alternating current motor that may be readily wound and rewound

Boys are employed in factories at low wage for the hand-manipulation of the old type of small motors in order to sell them at any profit, while repairs to them after leaving the factories are well-nigh impossible. All this will be done away where the new removable core is used, and the salvage in machinery itself is notable. It is reported that the demonstration of the device has astonished and delighted the leading electrical men of California.



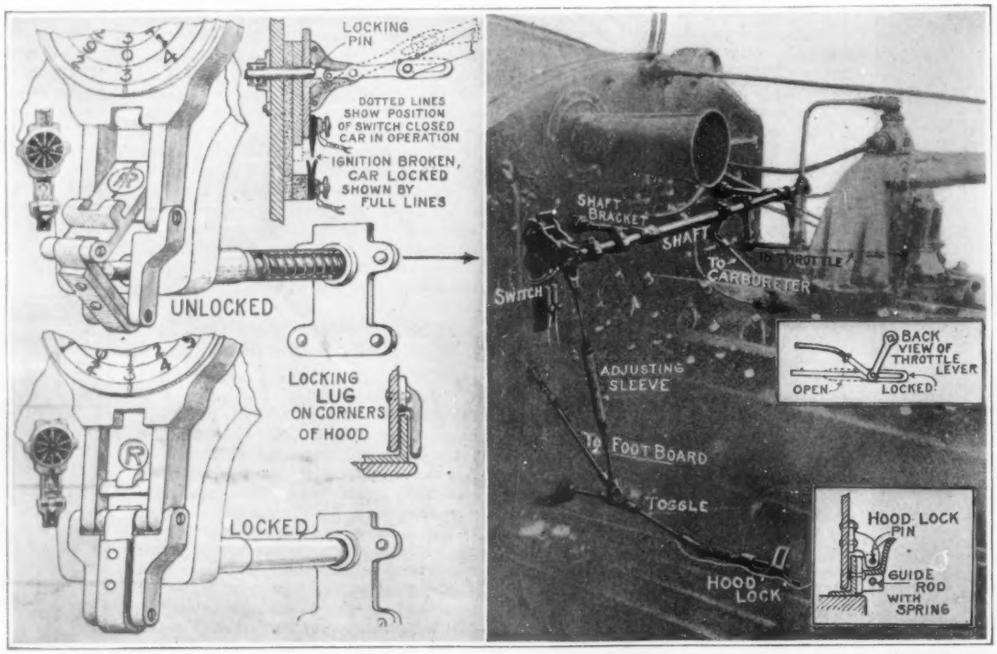
Shaping a "stick" into a mast with a new rotating plane machine

An Automobile Lock that Locks

THE object of the invention shown in the accompanying large illustration is to provide a means for securely locking an automobile to prevent theft, joy riding, or the towing of the car against the owner's wishes. It consists of a plurality of locking devices within the hood, controlling the hood, carburetor, throttle and electric connections to the engine. These locking members are all controlled and moved simultaneously into a locking position by pressing a foot pedal that passes through the foot-board of the car, and when locked they are kept in that position by a combination lock located on the dash of the car directly in front of the driver. To lock the car all that is necessary is to press the foot pedal and spin the combination lock. To unlock the mechanism, the combination is set and the lever is lifted.

The combination lock has 10,000 combinations which can be changed at the will of the operator. When a car is locked, it is impossible to remove the combination lock from the dash without knowing the combination for the reason the bolts that fasten the lock in place are covered and the combination must first be obtained and lock opened before it is possible to remove it. To prevent joy riding or the unauthorized use of the car by persons other than the owner, there is a place in the lock to put a small paper disk with the owner's initial on same as shown in the illustration, with the letter "R." Should the lock be opened through some one getting the combination, which is one chance in ten thousand, this disk is broken as shown in view of open lock.

The new device locks a car in eleven different places with one movement of the foot. When this is done, the hood is locked on both sides at the ends and in the middle. The carburetor and throttle are locked and the electric switch controlling the current to the plugs is broken. These are all controlled by the foot pedal and combination lock on the dash as clearly shown in illustrations of same. Another feature of this lock is to stop the theft of parts of the engine while standing in a garage, tampering with the carburetor, etc.



Details of the new system for locking the hood and the various members of the automobile power plant to prevent theft

Electric Trains Without Crews

(*Continued from page 426*)

cels. No trailer cars without motors were used. The main body of the car was placed between the wheels in order to reduce the height as much as possible. The lid of the car opened like that of a trunk, except that it was double hinged and could be opened from either side.

The cars weighed about 900 pounds, empty, including the four-horsepower motor, which was of a special design and shunt-wound, as already stated.

One of the most novel features in connection with this system consisted in the fact that the fields of the motors were excited through their own collector shoes from a conductor rail, entirely independent of that which supplied the current to the armatures. In view of the fact that any momentary interruption of the field current of a motor causes the low resistance armature to act as a short circuit to the line, this separate excitation of the motor field presented a problem to be carefully considered. By means of a special collector shoe, however, the difficulty was entirely overcome. No short circuiting of the line by the armature ever took place, although the field conductor rail was sometimes heavily coated with rust.

The two conductor rails were placed between the track rails, which served as a common return conductor.

The acceleration of the trains was accomplished by providing sections of the armature conductor rail supplied with successively increasing voltage, while the field remained constantly excited at full strength. The braking was similarly accomplished, except that the voltage successively diminished, thus causing the motor to act as a generator and deliver electric energy through the conductor rails back to the power system and in this way exercise a powerful braking effect. At the section upon which the train was to stop the armature conductor rail was connected to the tracks, thus closing the armature circuit and continuing the braking effect until the train was brought to rest. With this method, the accelerating and braking effect can be readily calculated and the proper length of the sections accurately determined. The braking section can therefore be laid out so as to locate the stopping point whenever desired.

In a system to be operated without motormen it is of vital importance to know exactly where the trains will stop and to have them stop in the right places. This would be impossible with any form of friction brakes for two reasons: In the first place, the braking effect is the same regardless of the load; consequently the braking distance is roughly proportional to the load and loaded trains require approximately fifty per cent greater distance in which to come to rest than empty trains. Moreover, variations in the condition of wheels and brake shoes produce a corresponding variation in the coefficient of friction and braking distance. With motor braking, on the other hand, the braking effect is greater for loaded trains than for empty trains, and this self-compensating tendency can be controlled to a nicety so that trains come to rest at the same point regardless of load. In practice the variations were slight.

When there are curves of too short a radius to be negotiated at full speed, it is necessary to provide for slowing up the train just as the motorman would do if in control. This is done by providing a braking section before such curves and supplying reduced voltage to the armature conductor rail upon the curve. Upon the Chelmsford line one such curve occurred, as already stated. The trains approached this curve at thirty miles an hour. A short distance from the curve they entered a braking section and were retarded to twenty miles per hour at the entrance to the curve. The best proof of the reliability of electric motor braking is the fact that in three years no accident ever occurred upon this curve, although the calculated derailing speed was twenty-six miles an hour. It is quite certain that no such record could have been made under manual control.

Although the shunt-wound motor has constant speed characteristics and there is little or no tendency for one train to overtake another, it is nevertheless necessary in a system of this kind to provide block sections, if only to prevent trains from arriving at the station more rapidly than they can be unloaded and thus causing rear end collisions at the unloading platform. The Chelmsford line was divided into blocks, each train as it passed closing the first block, and opening the second block in the rear. The blocks were electrically interlocked so that a closed block could not open until the next succeeding block was closed. In reopening, each block would assume a condition suitable for starting a train by progressively increasing voltage if a train were standing upon it at the time, but would go at once to a condition for passing a train over it at full speed if it were unoccupied at the moment of reopening. The control of the blocks was by means of the current flowing to the motor field, the field conductor rail being divided into sections corresponding to the blocks for this purpose. Thus there was a complete absence of stops, treadles, or other devices along the track, to be operated mechanically by the trains. The first block was at the exit to the station, so that the train would stop within sight of the operator if the line was not clear and move out of the station automatically as soon as the block cleared. Upon reaching a station, the trains normally stopped short of the receiving platform, unless and until definitely admitted by the operator.

The responsibility for trains and control over them of course passed out of the hands of the operator the moment they left the station. The station controllers were interlocked with the block system so that no oversight on the part of the operator could admit a train for which he was unprepared. Although the responsibility of the operator ended the moment a train left his station, he could nevertheless follow its progress whether toward or away from his station by means of a diagram of the line placed before him on the control table upon which the positions of the trains were at all times indicated by illuminated sections. This indicator system was likewise operated by the field current and by the same relays that operated the blocks.

The selective apparatus consisted of a stationary ramp placed alongside the track and a wiping contact upon the train that could be adjusted to make contact or not to do so at any particular station. The track switches were operated electro-pneumatically. Reversing of the cars in the station for the purpose of backing them off from sidings, etc., was accomplished without reversing switches in the cars and with only *three* connections from the car to the controller, by a novel method which consisted in connecting the field in shunt with a resistance in such a way as to reverse the field.

A trip around the line in one of the cars gave an uncanny sensation of control by an invisible intelligence. At the approach to the sharp curve the uninitiated always experienced a lively apprehension of impending disaster, which the car itself seemed to realize just in the nick of time and to avoid only by the most strenuous braking.

The system was inspected by Mr. Herbert Samuel, Postmaster General, and many members of Parliament, also by the French Minister of Posts, in 1912. It was likewise inspected by Mr. Hobhouse when he succeeded Mr. Samuel in 1914. An appropriation of £1,100,000 was voted by Parliament a few months before the war broke out for the construction of 6¼ miles

(*Continued on page 437*)

A Sure Foundation

CLAMPS and LATHE DOGS are essential tools in all railroad shops. Since they are indispensible to what may be termed basic operations, they form an important part of the foundation on which is built economical production.

Build *your* foundation strong and sure—use the dependable, sturdy strength of Williams' Superior Drop-Forged Clamps and Lathe Dogs. They'll never fail you and will last a life time. All are acknowledged *standard* everywhere.

CLAMPS—11 patterns, in a wide range of sizes for every clamping purpose.

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With the Engineers of Industry

A Department Devoted to the Physical Problems of the Plant Executive

This department is devoted to business men, works managers, production engineers, and all other executives seeking the maximum efficiency in carrying on their work. The editor of this department will endeavor to answer all questions relating to plant equipment, factory management, and industrial affairs in general.

What European Industrialists Are Doing

THERE can no longer be any doubt about the renaissance of the Old World's industry which has taken place in Europe since the Great War. Whether it is due to the serious loss of manpower or to making the acquaintance of some two million young Americans and their way of doing things, or a combination of these two things, the fact remains that European industrialists are rapidly coming around to the modern way of working.

It is a mistake to believe that European manufacturers still employ a preponderance of manual labor in preference to machinery. The European laborer has more or less kept relative pace with his American brother in the matter of higher and still higher wages, with the natural consequence that the industrial leader has been forced to consider machinery wherever possible.

Thus European factories today employ the last word in transportation systems, such as gasoline and electric tractors and trailers, lift trucks, all kinds of conveyors of the gravity and power-driven categories, automatic lathes and other machines, direct and indirect lighting, the so-called "window walls" in which the entire wall is composed of windows, steel shelving and steel furniture, wire fences, and so on. In fact, we Americans are no longer unique in our employment of such ultra-modern devices, and it is well for us not to rest too long on our past laurels.

The European worker has always been a hard worker, but not always so fortunate in the matter of wages as he is today—at least if he is employed today. Coupled with his hard work and skill, there is the latest kind of equipment and every labor-saving facility that goes to make good work with the least effort. It seems very much as though the European industrialists are going to give American manufacturers a stiff fight, using the very tools and methods on which we have always succeeded in the past in holding our own.

Saving Fuel with Powdered Coal

THERE is nothing new in the suggestion to employ powdered coal, to be sure; but of late the methods of using such fuel have been developed to such an extent that many large users of coal can with considerable profit turn their attention to powdered coal. It is claimed by certain manufacturers of powdered coal equipment that a decided gain in steam generating economy with increased boiler capacity follows the more perfect combustion of the lower priced fuels that is obtained by burning powdered coal. The higher furnace temperature and simplicity of control with very great flexibility to swing the furnace output with the load makes this established combustion method ideal for the modern industrial plant and central station.

According to tests recently performed by two fuel experts with Illinois coal, it is learned that contrary to the customary specifications, it is not necessary to pulverize the coal to the extreme fineness of 85 per cent through a 200-mesh screen in order to obtain good combustion and good efficiency. This ability to burn coarser coal means increased capacity of the pulverizing mills and decreased cost of coal preparation. The results also show that it is not necessary to dry coal to about 1 per cent moisture in order to burn it successfully in pulverized form, and it is stated that with most eastern coals drying is not at all necessary. Good results can be obtained when the coal is burned at rates varying from 0.5 lb. to 2 lb. per cubic foot of combustion space per hour, and the best results at a rate of 1 to 1.5 lb.

Fortunately for the industrialist who wishes to give some thought to pulverized coal, there are specialists in this field who are prepared to give specifications and costs for the conversion of an existing plant or for the erection of a new plant. In either event the pulverized coal idea is no longer an untried one, and it is worthy of serious thought.

Electric Furnaces for the Shop

BY leaps and bounds the small electric furnace is coming into general use for the fusion of bronze, babbitt metal and the various alloys of aluminum and bronze. The reasons given for the growing popularity of the small electric furnace in this connection are: 1. It is economical to operate. 2. The metal or alloy that is melted in the closed chamber of such a furnace is kept pure and has greater mechanical strength than is obtained with the usual furnaces. 3. The ease with which the electric furnace may be charged, poured and generally handled. In Europe, too, the small electric furnace is coming into general use.

Avoiding the Flywheel Disaster

AMONG the rare accidents that may happen in a power plant in which engines with large flywheels are employed is the bursting of a flywheel. Fortunately, such accidents are a very uncommon occurrence, but the results of a flywheel disaster generally take the form of one or two wrecked buildings, much crumbled and useless equipment, and the taking of several lives. Some form of insurance or protection against this event seems worth considering.

There has lately been developed an automatic engine stop that is claimed to preclude a flywheel disaster. This device, which is really an automatic valve, will automatically cut off the steam flow to the turbines or engines the instant that the speed goes beyond the predetermined limit of absolute safety. The assured safety of this device follows the simple rugged construction and the frictionless operation of a gravity actuated, weighted lever and the careful engineering that is back of each installation. In addition to shutting down the power unit automatically in case of overspeed, the engineer can instantly stop the unit from any desired point by simply pressing a button or breaking the glass of a hand-stop station.

A Metal-Wood Product of Promise

THERE is a genuine novelty about the metal-wood product that has recently made its appearance and that is available for a large number of purposes where an extremely strong yet light, even surface is required. The new product consists of two sheets of metal between which is sandwiched a filler of wood. The metal flanges are claimed to function like the flanges of an I-beam. The non-metal core spreads steel faces far enough apart to get maximum strength with least weight. The product is said to present an even surface like that of furniture panels. It is impervious to moisture, will not warp or lose its shape, the hard metal surfaces resist abrasion, and it is surprisingly light. Engineering tests of this new product have shown surprising results, among them the fact that the stiffness of a 5/16-inch-thick piece of the new material is equal to five times that of 5/16-inch-thick solid wood panel, or eighty times that of No. 19 sheet steel having the same weight. The elastic limit in bending of a 5/16-inch-thick piece is reported as 75-inch-pounds per inch width, or about five times that of No. 19 sheet steel.

The new product is furnished from stock in panels, 3/16-inch, ¼-inch and 5/16-inch thick, size 30 by 96 inches, faces of black or galvanized metal No. 30 gage, with planed wood veneer cores. The weight is from 1.6 to 1.9 pounds per square foot. Some of the uses of the new metal-wood product are for automobile commercial body panels, portable houses, shipping containers, filing cabinets, lockers, cab roofs, tool chests, car roofs, doors, office furniture, concrete forms, signs, and so on.

Keeping the Windows Clean

HERE is a new thought—keep the windows clean. Quite obvious, you say; but it is a fact that in many plants the windows are overlooked and gradually accumulate so much dirt and dust that they are no longer windows in fact. A thick, hard crust of accumulated grease, rust, soot, scale and dust accumulates on the windows that have not been cleaned at regular intervals, with the result that the plant is obliged to get along on very little light, or artificial illumination is resorted to. In either event the results are unfortunate, for after all is said and done, there is no illuminant quite as good as daylight, even if daylight is free.

In those instances where the accumulated dirt on windows, skylights and monitors is such that soap and water no longer have any effect on the thick, hard scale, resort may be had to some of the special chemical compounds now on the market which dissolve the most stubborn dirt.

Simplifying the Ventilation Problem

YES, we are going to speak about ventilation once more—and perhaps a good many times more in the future, for the reason that it is the one phase of all industrial activities that generally receives very little if any thought, yet means all the difference between efficiency and non-efficiency.

Foul, heavy, odor-laden air slows up the worker no matter how willing he may be and his output varies at least 20 per cent, according to the ventilation of his workroom. The 11 o'clock brain fag, the listless waiting for the 5 o'clock whistle, with which every industrial manager is familiar, is due as a rule to lack of fresh air, one of the most vital contributing factors to the efficiency of the worker. In the average shop he needs 3,000 cubic feet of fresh air per hour. Give it to your employees and you will protect them from tuberculosis, pneumonia and other impure air diseases. So it is argued by industrial engineers, and with very good reason, that the installation of an effective ventilating system will pay the industrial manager generous dividends for years to come.

A natural draft ventilating system is the most economical and effective where it is possible to install ventilators that give positive, constant ventilation. An American manufacturer has recently introduced a suction ventilator that is claimed to exhaust more air, heavy fumes, or steam, per dollar of cost, than any other system. This is a big statement, no doubt, but the design is quite novel and appears to be radically different. Briefly, the new ventilator has a line of exhaust that is above the horizontal, the discharged air has easy upward course, and the suction force of the outside air rushing in through the cone-shaped suction tube, which is kept in alinement with the air current at all times, has no sharp angles or obstructions to lessen its power, and acts as a strong siphon, drawing the impure air up and out. The ventilator is said to be storm-proof, dust-proof and requires no attention. Its first cost is the only one.

Extinguishing the Factory Fire

PRACTICALLY every fire can be extinguished within the first five minutes if proper equipment is brought into use, by men who know how to use it, according to the National Safety Council. Successful extinguishment of fire does not, in general, require elaborate, expensive equipment; the essentials are the right kind of equipment suited to the existing hazards, kept in good condition and located in the right place, with men who know how to use it, and that it be brought into use immediately after the fire starts.

The principal reason for extinguishing fires is to prevent property loss. Nevertheless, it is also of vital importance for the protection of life. Even in well-constructed buildings, with ample exits, a fire which is allowed to spread may cause panic and injury if not loss of life. In buildings of inferior construction, with substandard exits, the safety of the occupants demands the most careful attention to fire-extinguishing facilities, as well as to fire alarms and drills and to fire prevention.

No matter how well equipped your plant is with fire-fighting apparatus, nor how well trained your men may be to handle this apparatus, it is of utmost importance that the public fire department be notified immediately when fire is discovered, in addition to your efforts with private equipment. When men rely wholly upon their own ability to extinguish small fires, serious losses often result which could have been prevented had the public fire department been notified promptly.

There can be no gainsaying that auto-

(*Continued on page 440*)

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Electric Trains Without Crews

(*Continued from page 435*)

of automatic electric railway connecting eight of the most important post offices in London. The tunnel was completed during the war. The contract for installation of the electrical equipment has been postponed on account of high prices. The London system will consist of a circular cast iron lined tunnel nine feet in diameter, accommodating two tracks with a gage of two feet, and the cars will be about ten feet long, five feet high and three feet wide, or considerably larger than the Chelmsford cars, although they are of the same general type. The specifications call for a direct-current system, operated by shunt-wound motors with field excitation from a separate conductor rail, and a line divided into blocks, with control in the station vested in an operator in a control cabin, all of which features characterized the Chelmsford system.

Molasses for Fuel

(*Continued from page 427*)

separation of the crystals from the molasses by whirling it rapidly in a machine described as centrifugal. The mechanism consists of a perforated basket, revolving inside an iron casing. The basket is lined with finely perforated sheet bronze or with woven wire cloth, measuring from 14 to 24 inches in depth and from 30 to 40 inches in diameter.

Revolving at a speed of from 1,000 to 1,400 revolutions a minute, the molasses is forced out through fine openings, caught in the iron casing and conveyed away in a conduit. The sugar crystals are retained in the basket, the latter being subject to spinning activity until the sugar is divorced from the molasses. The sugar is in a raw state, crystalline but lumpy, and due to impurities varies in color from a light tan to a dark brown. The molasses, carried off in the conduit, is boiled again and replaced in the machine for another offering of crystals, classified as "molasses sugar." The molasses, in its final form, was once marketed for the manufacture of rum, spirituous liquors, or alcohol. Limited use was made of blackstrap as a stock food or fertilizer, but its conversion into whiskey was its chief application.

The raw sugar, unfit for consumption as it comes from the centrifugal machine, is refined by first dissolving in hot water and the resultant liquor filtered through cotton bags as a method of removing insoluble impurities. Succeeding this process, the product is subjected to iron cylinders packed with charred bones; charcoal evidencing a strange affection for the soluble impurities. After filtration, the purified, colorless liquid sugar is boiled in vacuum pans, refilled as evaporation sets in, until the crystals have begun to reform, when the mass is again spun in the machines which separate the liquor from the crystals, according to the process previously described. These crystals, once having dried in horizontal cylinders, fit the description of the granulated sugar which we buy at the corner grocery store. Soft white sugar is the product of staying the process after passing through the centrifugals. The granulated product is obtained by controlling the crystallization in a granulator and by sieve grading. Loaf sugar is the result of diverting the mass formation as it comes from the vacuum fans into molds, where it drains; and then placing the molds into ovens to be solidified. Pressed cubes are shaped from moistened granulated sugar. Strange anomaly, sugar in the process of formation is tested for quality by the way in which it refracts light rather than by its taste for sweetness.

The final residue is molasses, which is to be profitably utilized as fuel, and commercial potash by the chemical and mechanical process already indicated. Commercial potash is now commanding from

(*Continued on page 439*)

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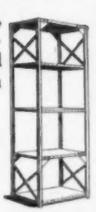

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Recently Patented Inventions

Brief Descriptions of Recently Patented Mechanical and Electrical Devices, Tools, Farm Implements, Etc.

Of General Interest

TIE PRESS AND HOLDER.—N. M. DYER, c/o U. S. Customs Ferry, Wash. An object of this invention is to provide a portable device which can be conveniently carried in the handbag of a traveler, and which will operate to hold any number of ties and exert sufficient pressure on the ties so as to smooth out the wrinkles. A further object is to provide such a holder as can be cheaply manufactured.

CLOSURE FOR CONTAINERS. — M. D. FINK, c/o Dwight P. Robinson Co., 125 E. 46th St., New York, N. Y. It is the principal object of the invention to provide a construction for the delivery and of a collapsible tube by providing a closure which forms a permanent part of the delivery end of the container. Another object is to provide means adapted to coact with the container neck to retain the closure in sealed contact when the closure is disposed over the delivery opening.

PLANT STAND.—D. F. LOUDON, 109 W. 102nd St., New York, N. Y. The object is to provide a plant stand for use in the house, in florists' windows and other places and arranged for holding and displaying potted plants at various angles relative to the light. Another object is to allow the user to turn the pot holder while in an inclined or angular position, to insure the proper uniform dropping of the stems and flowers without requiring changing the pot in the holder.

DEVICE FOR HOLDING PRECIOUS STONES.—A. J. BENJAMINS, 543 4th St., Brooklyn, N. Y. This invention relates to an apparatus used in connection with the cutting of precious stones. The principal object is the provision of a device for holding stones with which a gage for determining the correct axle of the facets may be used with out the necessity of removing the same therefrom. A further object is to provide a holder which will accommodate gems of various sizes without the necessity of changing the equipment.

MOTION PICTURE REEL AND CONTAINER THEREFOR.—H. HUMMELL, F. W. MARTIN and C. J. SCHWALL, address Harry Hummell, 12 75th St., Woodhaven, L. I., N. Y. The primary object of the invention is to so construct a film reel that it may be used as one section of a reel container for the purpose of storing the film when not in use. A further object is to so construct the container that it will be fire-proof, and that a number of the containers may be suitably secured together to facilitate transportation.

SKIRT MARKER.—F. W. SIMON, 940 Leavenworth St., San Francisco, Cal. The invention has reference more particularly to a device for gaging and marking the length of the skirt so that an even hem may be produced. The primary object is to provide a device which may be conveniently and effectively manipulated by the person wearing the skirt without soliciting the aid of some one to realize the desired results.

CLIP FOR CLOSING NON-METALLIC COLLAPSIBLE TUBES.—R. A. BACHMANN, c/o Sanitube Co., Newport, R. I. The invention has for its object to provide a clip for use in closing non-metallic collapsible tubes, which has pins serving to hold the tube in position when rolled. The clip is so constructed that when applied and the tube is rolled up tight, the tube will remain in this position until it is unrolled manually.

CLOTHESPIN.—Z. FONVILLE, c/o Carolina Wash Board Co., Haggett and Snow Sts., Raleigh, N. C. The object of the device is to provide a spring bridle of simple construction by means of which the jaw members are held in clamping relation. The pin comprises a pair of jaws, a wire bridle with ends secured, including a single strand between the jaws, forming a fulcrum and exerting spring tension when the jaws are open and said strand is put under a torsional strain.

DIVER'S SUIT.—H. HOUDINI, 278 W. 113th St., New York, N. Y. Among the objects of the invention is to provide which the diver may put on or take off without requiring assistance, the suit being so arranged as to permit the diver, in case of danger, to quickly divest himself of the suit while being submerged and to safely escape and reach the surface of the water. Another object is to prevent the diver when submerged from being crushed by the pressure of the surrounding water in case the air supply gives out or the air line becomes fouled from any cause.

PROCESS OF MAKING RECEPTACLE CLOSURES.—A. L. BERNARDIN and G. P. PFIRRMAN, Evansville, Ind. The invention relates to a process of manufacturing closures for receptacles such as bottles with a lacquered sheet without endangering the lacquered surface. An object is the provision of a process in which the cylinder and its cap, making up the complete closure, are joined by pressure applied lengthwise of the cylinder and thus avoiding lateral pressure and the danger of mutilating the cylinder.

METHOD OF MAKING TUBES.—R. W. LOWE, c/o Conn. Brass Corp., West Cheshire, Conn. Among the objects of the invention is the provision of a method of making tubes in which a clogging and bending of the parts will be eliminated, and the delay incident to cleaning the same will consequently be avoided, also the objection incident to utilization of a billet, which is circular in cross section, is avoided.

ASSORTING TRAY.—W. S. SHEPPARD, Box 416, Colorado Springs, Colo. The general object of the invention is to provide a tray for papers of various kinds, and particularly to the maintenance of checks, deposit slips and the like in ordinary files during posting, thereby increasing the efficiency while lowering the possibility of error in posting to the wrong account. It is a purpose to provide a tray which is of simple and inexpensive construction.

BED.—J. P. DIECKMANN, Route 2, Oakfield, Wis. An object is to provide a bed which will give readily with the weight of an occupant. A further object is to provide a bed in which the spring and mattress instead of being supported upon the side bars of a bed frame are supported on a frame suspended from a cross bar attached to the head and foot pieces of the stationary bed frame.

DIAPHRAGM FOR PHOTOGRAPHIC LENSES.—G. W. COOPER, Shaftesbury Hotel, Great St. Andrews St., Shaftesbury Ave., London, England. The invention particularly refers to diaphragms of the kind provided for the purpose of obtaining stereoscopic or relief effects by means of superposed images. The object is to enable artistic effects to be readily obtained, which effects have hitherto been produced only imperfectly either by a combination of lenses or by means of a gauze cap placed over the lenses.

PHOTOGRAPHIC FILM SEALER.—V. ST. C. BRACKETT, Liberty Block, Moncton, N. B., Canada. This invention has for an object to provide a construction which will seal the exposed film before removing the back of the camera containing the film. A more specific object is the provision of an adhesive strip arranged to overlap part of the body of the film together with a tearing member connected so as to cause the adhesive member to move to an opposite position when the film has been completely rolled after exposure.

HANDBAG HANDLE.—H. E. WALTER, 729 28th St., Oakland, Cal. This invention relates particularly to that form of handle which comprises two members and is commonly known as a split handle. It is the object of the invention to provide means for removably locking the two handle members of a split handle together by a fastener which may be readily attached which will be practical and will not increase the cost of the bag.

FLOORING.—S. HEDGES, 4607 Welsh Place, Los Angeles, Cal. The invention has for its object to provide a veneer flooring having a tongue and groove joint, simple to form, and easy to put together, and which shall, under all conditions produce a smooth surface, and which will provide a great saving in the first cost of the flooring.

DISPLAY DEVICE.—S. M. BENJAMIN, 302 W. 22nd St., New York, N. Y. An object of the invention is to provide means for supporting and moving a form on which dresses, coats and other garments are supported so that the garments can be effectually displayed from the front, back and the sides in show windows to attract attention. A further object is to provide a construction of track and a car for the support of the form, and an electric motor.

CENTERBOARD.—F. A. GRAHAM, Harbor Springs, Mich. The invention relates to sailing vessels, and has for its object the provision of a centerboard which is made of fabric which can be folded to occupy a minimum space in the boat. A further object is to provide a centerboard which may be cheaply constructed and may be operated from the stern of the vessel without leaving the rudder.

ADVERTISING DEVICE. — C. GARCILLAN, address B. La Hoyas, 99 Nassau St., New York, N. Y. It is the primary object of the invention to so construct a sign, of the interchangeable letter type, that the several letters thereof may be placed in display position and removed at will. It is a further object to so construct a letter supporting means that plates of various sizes may be used in connection therewith.

PAINT.—H. N. WELLS, 1207 Willow Ave., Hoboken, N. J. An object of the invention is to provide a paint which serves as a substitute for what is known as "rubber paint" and which will effectively cover oily or greasy surfaces. A further object is to provide a paint which may be used in connection with sound proof material as a covering therefor. The paint comprises the following ingredients: Soap, 9 ounces; whiting, 2½ pounds, lime 23¼ pounds; salt, 1¼ pounds; water, 4 gallons; to which is added coloring medium.

DEVIASCOPE.—S. A. ELLINGS, 3704 20th Ave., S. W., Seattle, Wash. This invention relates more particularly to a device which is designed for use by students of navigation as a medium for illustrating compass deviation due to lines of magnetic force in a ship, particularly a steel ship, and also illustrating the manner of correcting such deviation through the employment of ordinary means on the ship.

Machines and Mechanical Devices

APPARATUS FOR PULLING PLIES OR THE LIKE.—J. A. PURVIS and H. A. SESSIONS, 216 W. 10th St., Traverse City, Mich. The invention has for its object to provide an apparatus for pulling plies or the like, and relates more particularly to a machine designed for pulling plies of fabric from old pneumatic tires, to be used as reliners and patches in vulcanizing work. With this device a tire may be quickly stripped, and with but little labor.

SAFETY ATTACHMENT FOR THE SUCTION PIPES OF CENTRIFUGAL PUMPS.—J. C. HOGUE, address W. J. Bacon, 54 Goodbar Bldg., Memphis, Tenn. The invention relates more particularly to safety devices, the object being the automatic relief of back pressure or water hammer in case of clogging of the suction head, to prevent pump destruction, and a further object is the provision of a device which will allow of external connection of a priming device with respect to the pump casing.

CHANGE SPEED GEARING.—W. W. WILSON and J. L. PERRY, R.F.D. No. 2, San Luis Obispo, Cal. The object of the invention is to provide a change speed gearing especially adapted for use in connection with the standard plunger drive mechanism of well pumps and which is effective to double the frequency of the stroke or linear speed of the pump plunger over that normally imparted thereto whenever conditions make it desirable for a relatively high rate of plunger reciprocation.

CONTROL HEAD FOR OIL WELLS.—D. BREEDING, address Nelson & Blair, 203 Security Bldg., Tulsa, Okla. The invention relates generally to apparatus used in the drilling of oil wells, and particularly to a control head, a purpose being the provision of a control head which permits the application and removal of the oil sealing device while the drilling tools and cables are suspended within the well without permitting the escapement of oil from the head.

BARREL PRESS.—J. A. COHILL, Hancock, Md. This invention has for its object to provide a device especially adapted for placing the heads in filled barrels of potatoes or the like wherein a fluid pressure controlled plunger is provided upon which the barrel is placed, the said plunger being at the floor level, and wherein the controlling mechanism causes the plunger to move upwardly to lift the barrel into contact with a fixed abutment to force the head into place.

MARKING MACHINE.—C. E. LARSEN, 2620 W. Division St., Chicago, Ill. An object of the invention is to provide a device which can be operated manually, having means for accurately, expeditiously, and effectively marking a desired pattern upon cloth, or the like, whereby a great saving of time and labor results, and by means of which provision is made for a change of pattern at will.

VIBRATING MOTOR.—K. EDISON, Spring Valley, N. Y. Among the objects of the invention is to produce a motor which may be adapted for use as a source of power for operating figure toys. A further object is the construction of a motor which will operate efficiently while extending in either an upright or downward position, and a pawl mechanism which may be relied upon so that the breakage of the spring due to backlashing is entirely precluded.

Pertaining to Vehicles

REFLECTING DEVICE FOR AUTOMOBILES.—H. B. DAVIDSON, 3206 N. 29th St., Tacoma, Wash. An object of the invention is to provide means whereby the driver of an automobile may obtain a perfect view of the road to the rear of the car from the driving seat without taking his eyes from the front of the car. Another object is to produce a reflector by means of whihch the driver can obtain a rear view or view at any lateral angle.

TRAFFIC SIGNAL.—A. N. MENDELSON, 267 W. 143rd St., New York, N. Y. The invention has particular reference to a directional indicator for automobiles or other road vehicles, particularly large motor trucks. A further object is to provide a device which may be manufactured at a minimum expense in a standard size and which is readily adjustable to vehicles of various widths.

TRACTOR.—VAN V. AERL, Waco, Texas. The object of the invention is to provide a device of the character specified wherein the propelling force is delivered through tractor blocks which are swung in succession into and out of engaging position with the ground, to advance the tractor, each block is provided with a toothed undersurface to secure a firm grip upon the ground.

TIRE HOLDER.—R. C. MONTGOMERY, 183 Monroe St., Brooklyn, N. Y. An object in view is to provide a holder which may be fastened rigidly to certain parts of an automobile, or adjustably connected to a permanent rim carrying wheel or fixture. A further object is to provide a holder wherein the carrying arms are radially movable so as to snugly fit into a tire-carrying rim and to properly fit demountable rims carrying tires.

SPEED CHANGING MECHANISM.—O. HILL, 811 E. Jefferson St., Crawfordsville, Ind. It is a purpose of the invention to provide a speed changing mechanism for motor vehicles in which the necessity of shifting the gears to secure the various speeds is eliminated, thereby preventing the possibility of dripping the gears and dispensing with the usual objectionable noise incident to the shifting operation.

TIRE FASTENER.—A. O. KUNERT, c/o T. H. MCENROE, 1 and 2 Kennedy, Fargo, N. D. The invention has for its object to provide a fastener wherein a sectional rim is provided, consisting of sections slidable upon each other and having interengaging means for constraining them when they are moved circumferentially with respect to each other, to cause them to grasp the holding beads of the tire or to release the same, and wherein means is provided for moving the said sections in either direction, and for locking them against reverse movement.

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Molasses for Fuel

(*Continued from page 437*)

$250 to $360 a ton, whereas the pre-war figures were only $75 a ton. During the World War as high as $1,000 was paid for a single ton. Not only agriculture places demands upon available potash sources, but the product is used in the manufacture of chemicals and soaps. The possibility of obtaining 150 pounds of potash from every ton of blackstrap molasses may ultimately relieve the stringent demands placed upon Alsace-Lorraine and Germany, premier potash-producing regions of the world. The commerce-carrying cargoes that ply between Cuba and the United States, bearing barrels of sugar, may alternate the burdens of their consignments to read, "Potash from the sugar-manufacturing establishments, thanks to mechanical ingenuity and the variable uses of blackstrap molasses."

The Roger Bacon Manuscript

(*Continued from page 432*)

exception he conceives the reproduction processes as under the beneficent direction of certain intelligences which Professor Newbold aptly describes as "the little life-giving spirits." The drawings are full of these spirits, represented as female figures, some naked and others clothed, but all possessing the fat and tubby lines of the kewpie. If full credit be given the scribe for all the objective representations which Professor Newbold believes the drawings to contain, these spirits are represented as guiding the sperm, the ovum, etc., in their careers, as conducting the individual spirits from heaven to the bodies which they are to occupy, etc., etc. On this page we reproduce a representative bit of the manuscript dealing with the phenomena of plant life; those in which the subject is animal reproduction are hardly suitable for general circulation and are therefore omitted.

It is on these drawings that opinion splits widest. Taken without consideration of any text which might or might not be offered with them, they might mean everything or nothing. The scribe was not a great success as an artist; his efforts sometimes remind us of the crude outlines which we produce in impressing upon the draftsman what we want and how we want it. On the other hand, it is quite plain that the drawings do possess some symbolic significance; and the question arises of where the symbolism halts and objective representation begins. Professor Newbold claims without reserve that we have here an attempt to picture, with considerable objective detail, the microscopic structure and processes of sperm, ovum and embryo, of pollen and seed.

Dr. Clarence McClung, University of Pennsylvania embryologist, states boldly that he cannot follow this argument. To a group of nine rather large drawings on a folded insert in the manuscript, which Professor Newbold believes to be micro-drawings of as many successive states of the human embryo and its surroundings, Dr. McClung considers it impossible to assign any objective meaning at all save perhaps in two instances, and in these he is very cautious. Admitting the difficulty of disentangling symbolism and objectivism, Dr. McClung is unable to find anything in these drawings which impresses him as a good representation of natural structures or processes. He states categorically that if they are admitted to be what Professor Newbold would have them, they would involve better observation than could be made with the naked eye, but probably would call only for the use of a simple magnifying lens. Again the coupling of Bacon's name with the microscope is rebuked.

It really seems that at times Professor Newbold allows his wishes to run riot with his better judgment. On one page

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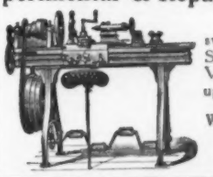
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he finds, wandering down the border for a distance of several inches, a long, thin thing which we should never, on our own initiative, suppose to be anything other than a conventional border ornament. If it were insisted that we find an objective representation for it, we should say that it looks more like the uncoiled end of a roll of ribbon than anything else—there is the merest suggestion of form to the end, but certainly not enough to make this end pass for the head of an earthworm, let alone of a sperm. Yet Professor Newbold makes the categorical statement that it is a sperm, and that biologists to whom it has been exhibited have unreservedly pronounced it to be a sperm. Dr. McClung's comments on this item may be epitomized in the statement that he mentions it with an indulgent smile. We should be inclined to smile with him, but more broadly.

The most liberal estimate that we are able to make of the objective side of the biological drawings, as a whole, is that they show nothing that is not known to every layman today; nothing which we can conceive as unknown to any anatomist of Bacon's time; little enough which the mere survival of the species, coupled with our knowledge of medieval morals, does not demonstrate always to have been known to the race at large. Presented in connection with a thirteenth century textbook we might then be inclined to admit them.

In connection with a thirteenth-century exposition of new knowledge of such startling and unorthodox character that it had to be hidden beneath a six-fold cipher with two arbitrary processes of guess-work in its solution, we do not see that they can possibly be of the significance which is attributed to them. We should greatly prefer to interpret them as part of the statement of some secret, unorthodox ritual and creed, which there would be mighty good reason for concealing from the authorities with as many layers of cipher as the scribe's imagination would permit. In such connection the very features which prove now most puzzling would become the most significant, and the biological pages of the work would present a much more harmonious whole with the astrological sections.

Nor are we able to follow Professor Newbold in his opinion that such passages as he has presented in deciphered form are with plausibility assignable to Bacon. While Bacon was centuries ahead of his own time in scientific ability, he was after all of the thirteenth century and subject to the fundamentals of that century. We know that he was an astrologer and an alchemist and a churchman; in all these things we may be confident that he was not a step ahead of his time—we may find ample evidence to justify this conviction. His leaning toward experiment as a substitute for the dicta of Aristotle was his sole weakness, measured in terms of contemporary opinion. So we must not expect too much from him; and the drawings, assuming them to be his, show rather plainly that we are not getting too much.

On the face of this, Professor Newbold offers the following translation in connection with one of the biological drawings: "Here the souls are growing and extending themselves. You see the essential aggregations of the sacks (*i.e.*, cells) are being severed into bonds between the kernel and the fragile membrane of the egg, but there are arising points between the external masses of cells at that point." This we recognize as an effort to state present-day knowledge of reproduction by fission without the facilities of the present-day vocabulary.

Our feeling is without reserve against the possibility of such a passage in Bacon. It will be noted that this description is not of mere microscopic structure, etc., which any novitiate of decent intelligence with a decent glass might fairly be expected to get reasonably correct. We see described here, with an approach to accuracy, processes which the most brilliant scientist could hardly interpret without a vast number of independent observations upon different stages of the processes described, and upon many different species. With the background of this character provided him today, an amateur scientist could readily make the generalizations that are made in this bit of text; without this background we do not see how a Bacon could be expected to make them, or a Darwin or a Haeckel. Even as an inspired guess like that of Democritus on the atom, we cannot swallow it. Our only conclusion is that modern knowledge has been read into this passage and others like it.

The judgment that this manuscript really is a Baconian one impresses us as inherently reasonable and as adequately supported by investigation. The translation offered impresses us as altogether unreasonable, both as regards the character of the cipher and the nature of the translated passages. Moreover, on Professor Newbold's own statement the cipher is so difficult that a preliminary impression of what the picture is about usually makes all the difference between success and failure in deciphering the text. As he throws page after page upon the screen, one gets so accustomed to association of the statements "I have not been able to decide what this picture is intended to mean" and "As yet it has not been possible to make anything out of this text," that any deviation from this association would stand out like a sore thumb. Let the translator decide what the picture is about, and he can produce a text which shall be about the same thing; otherwise he appears helpless. Until enough of the pages are deciphered without reference to the pictures, and found to give meaning to these, we must regard the *a priori* decision as to what the text is about as an essential feature of the "decipherment." This decision, coupled with the arbitrary steps in the translation, certainly robs the work of any slightest claim to scientific precision. A single arbitrary step in a cipher has been shown to make it almost a mathematical certainty that it can be made to say anything whatever; and Professor Newbold's procedure involves two such steps, coupled with a decision as to what it is desired that the cipher shall say. As a basis for further investigation his work may be of value; as anything more than this we do not see how it can stand.

Extinguishing the Factory Fire

(*Continued from page 436*)

matic fire extinguishers, such as sprinkler systems, are the best kind of protection for the very reason that they are automatic. They operate whether someone is on the premises or not, in the event of fire. However, a reliable water supply of ample capacity and pressure is essential for efficient fire extinguishment. Sprinkler systems and hose lines are valueless unless an ample supply of water under pressure can be maintained for an appreciable length of time.

The city line or water works connection, according to the National Safety Council, probably constitutes the most satisfactory source of supply where the plant is so located that such a connection is possible. Many plants have in addition a private source of supply, while others must depend entirely upon their private supply. This is provided from large reservoirs, elevated tanks, or a pump drawing from a stream or reservoir.

There are three general types of sprinkler systems in use: The wet system, the dry system, and the open system. In the wet sprinkler system the water (under pressure) stands in the sprinkler pipes continuously, and when a head melts, water is sprayed over the surrounding area. Where this system is used the building must be heated throughout the winter months. For unheated buildings, where the temperature would go below freezing, the dry system is necessary. In the dry sprinkler pipes are filled with air under pressure—20 to 35 pounds—and any release of this air pressure will automatically admit water to the pipes through a dry-pipe valve located in a heated valve room. The dry-pipe valve is so constructed that a comparatively low air pressure will withhold a water pressure two or three times as great.

The open sprinkler systems, though not in general use, are of some advantage for distributing water over the roof or sides of a building, and over wired-glass windows or steel shutters to afford protection against fire in an adjoining building. They are non-automatic in action, it being necessary to open a valve admitting the water supply to the sprinkler pipes which are located in readily accessible places on the outside of the building.

It is interesting to note that sprinkler heads are made in four different ratings which have melting points ranging from 160 to 360 degrees. The heads with a higher melting point are made for use in dry rooms, boiler rooms, and other places where a high temperature prevails and where heads of a lower melting point cannot be used. Care should be exercised, on renewing heads in such locations, that a head of proper rating is used. Heads of as low test as one can safely stand should be used, for the lower the melting point of the head the greater the degree of protection afforded by the sprinklers.

While fire pails and fire barrels may be provided at very low cost and have the advantage that their use is understood by all, there are certain disadvantages in their use, such as (a) difficulty of always keeping the barrels and pails full of water, (b) preventing their use for other than fire purposes, (c) a limited range and accuracy in the use of the fire pail, (d) the impossibility of reaching fires which may develop behind sheathing, within flues, or on overhead construction or ceiling.

Hand extinguishers, on the other hand, have a fairly good range, are easily maintained, are not likely to be used except for fire purposes, and throw a stream containing gas, which has exceptional fire extinguishing qualities. The possible disadvantages of extinguishers are that they cost somewhat more than fire pails and their operation is not always understood. Several types of extinguishers have been developed, the most notable of which are those which use as the extinguishing agent (a) the soda-acid solution, (b) carbon tetrachloride, and (c) a foam solution.

In purchasing extinguishers it is recommended that those bearing the label of Underwriters' Laboratories be given preference.

The soda-acid extinguisher in common use employs a solution of about a pound and a half of bicarbonate of soda to two and a half gallons of water, with an inner container of approximately four ounces of sulfuric acid. These are made in the "loose stopple" and the "break bottle" types. The latter are especially adapted for railroad and boat service where the swaying and rocking would splash the acid over into the soda solution thus rendering it useless. By inverting the extinguisher, or breaking the bottle (see directions on extinguishers), the acid is emptied into the soda solution, forming a gas the expansion of which forces out the solution under considerable pressure.

These extinguishers are valuable in free-burning fires where there is much draught. They are also of value in fighting fire on ceilings or between walls where it cannot be reached by fire pails. Sizes larger than two and one-half gallons' capacity are not recommended because of the inconvenience in handling. In schools and homes and other places where women and children may be called upon to use them, even a one and one-half gallon size is recommended.

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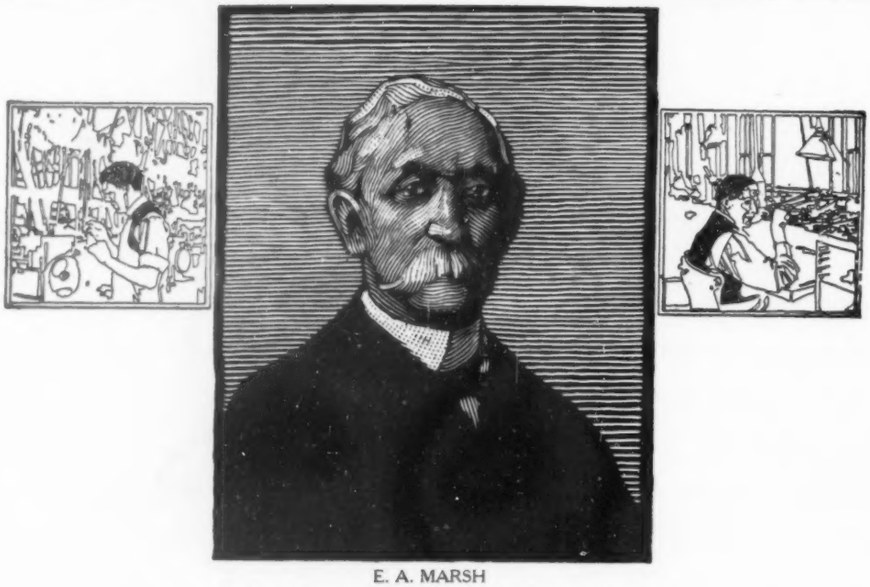

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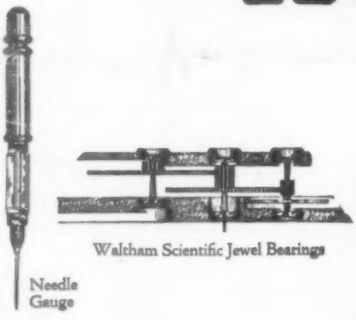

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